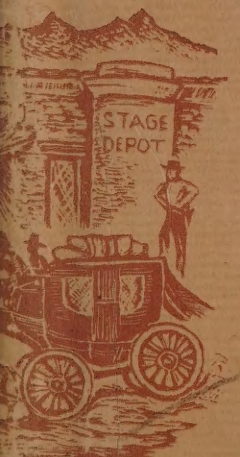
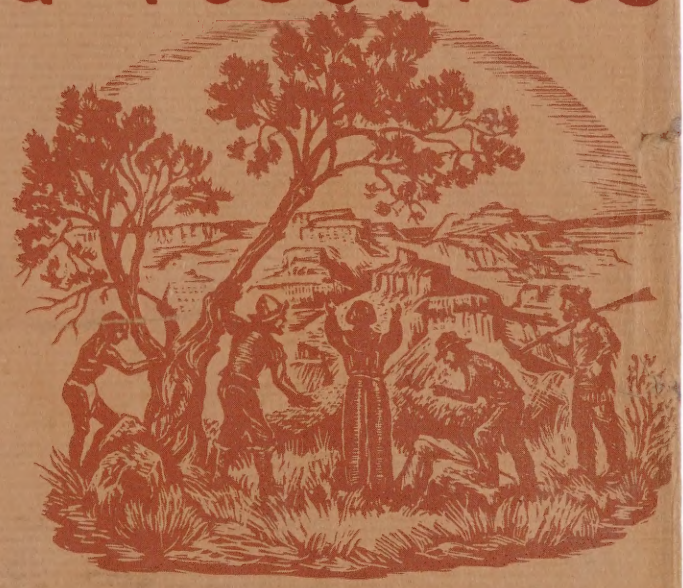
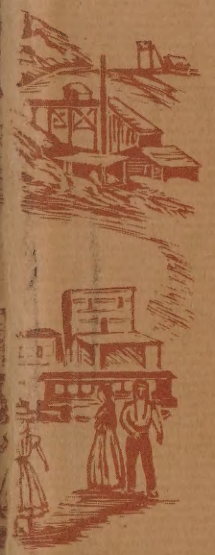




ARIZONA

its people and resources



ARIZONA

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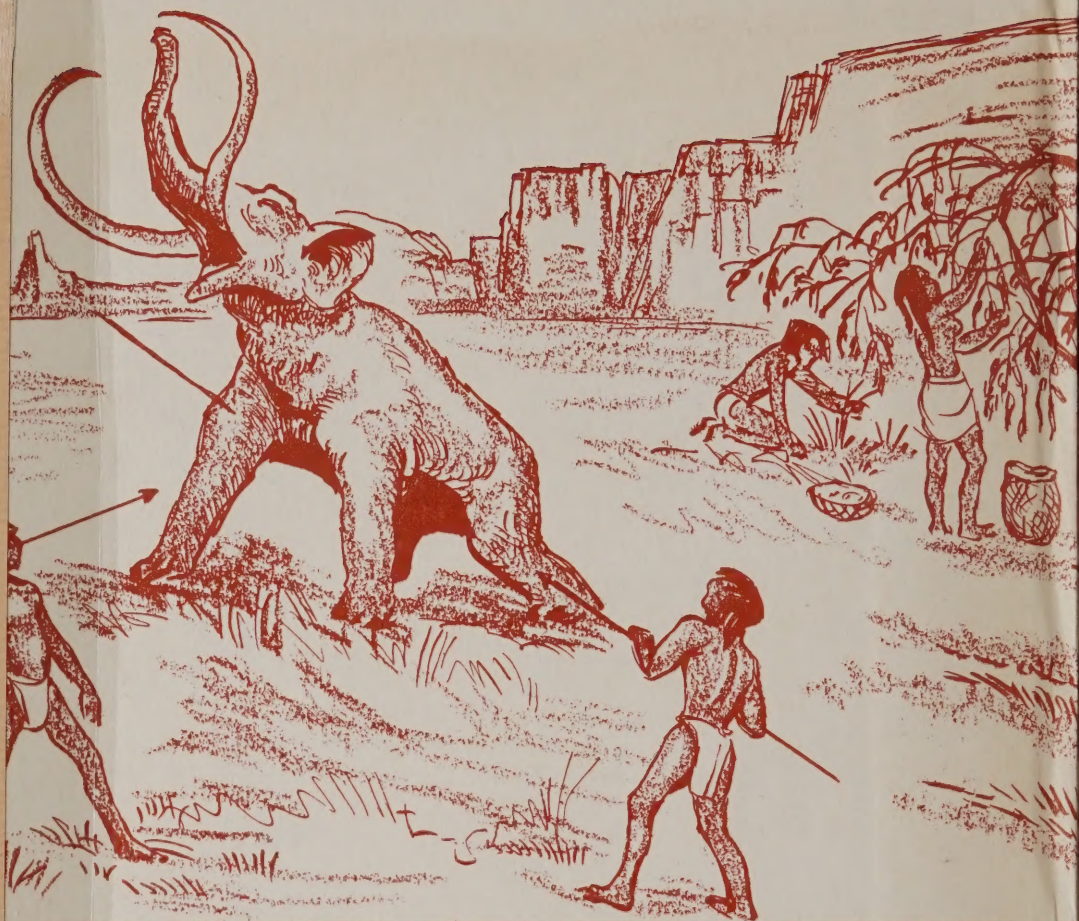
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TIME moved too fast in the recent century of Arizona's growth for Arizonans to record continuously the events of its passage. The world of Indian wars, rich ore strikes, and big roundups engaged the creative energies of the men and women who tamed the frontier, denying them the reflective leisure to write much about a region whose history stretches back a dim millenium or so, but has become abruptly more complex in the last one hundred years. To grasp this complexity called not only for pioneer energy and vision, but for patient study of old cultures, of climate, of the riches of earth and air.

Modern Arizonans have finally paused to tell the story. Fragments helped — pottery, calendars, canals, old journals, stories, pictures, and maps. But perspective and the long view toward Arizona's future had to come from today's people.

The story of *Arizona: Its People and Resources* is told by the state's writers, scholars, technicians and scientists — illustrated by Arizona artists with brush, pen, and camera. Making the record even as they write it are these specialists — unearthing history, contemplating laws, studying economic problems which more often than not relate to the great

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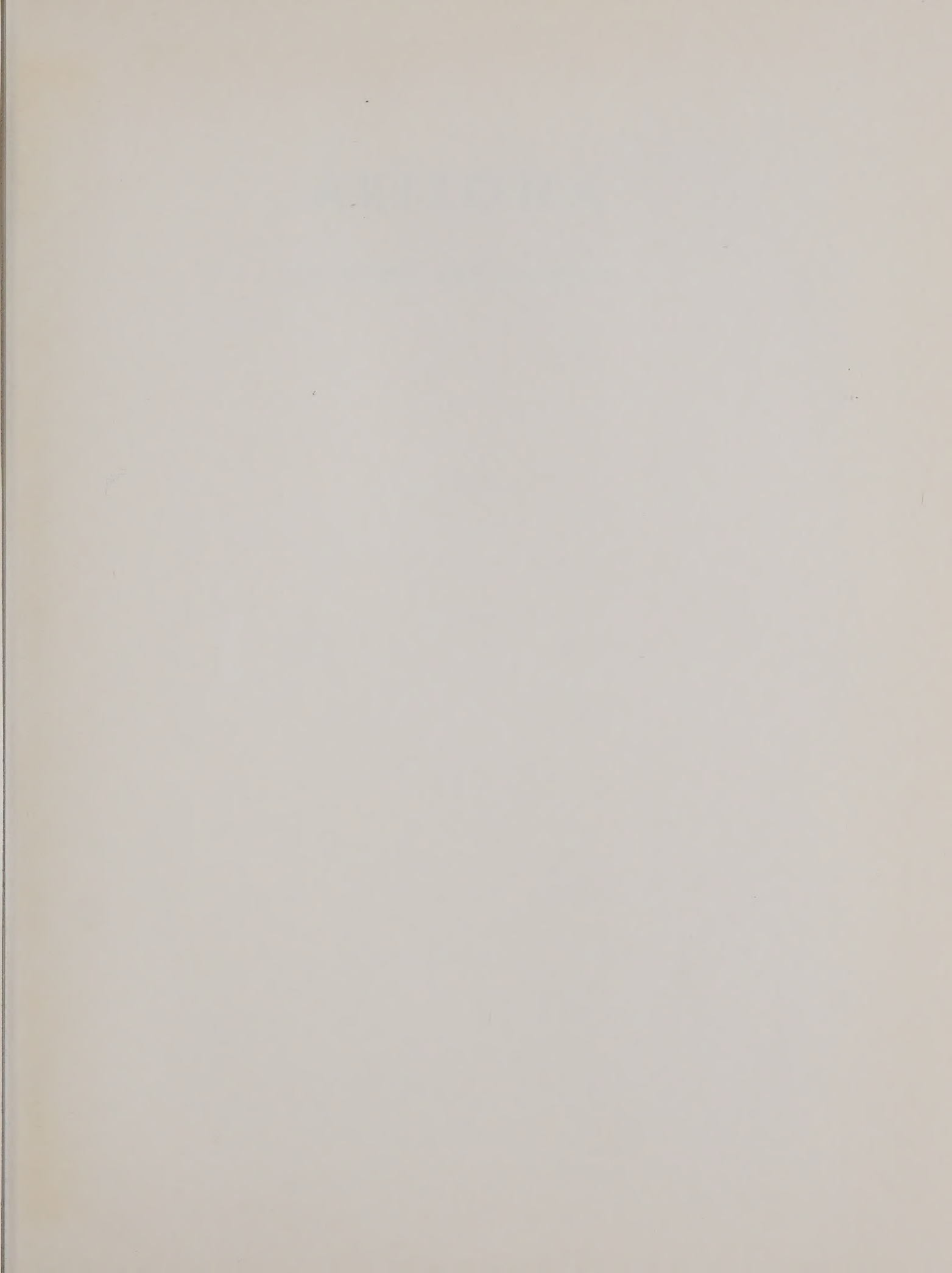
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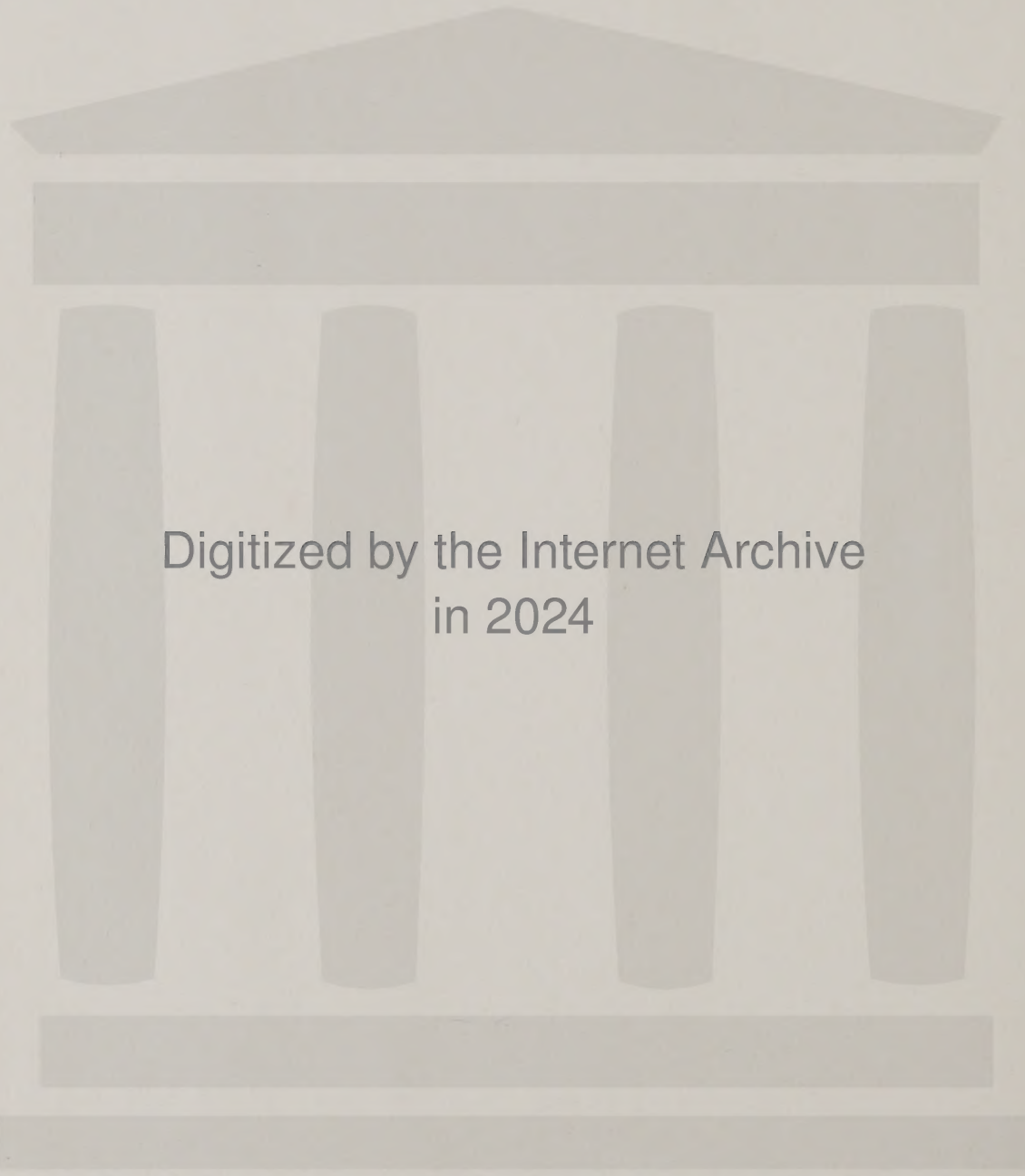
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Anne M. Peck





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ARIZONA

its people and resources





ARIZONA

its people and resources

*edited
by*

JACK L. CROSS
ELIZABETH H. SHAW
KATHLEEN SCHEIFELE

A Seventy-fifth Anniversary Commemorative Volume

C. ZANER LESHER
General Chairman, Seventy-fifth Anniversary Program

SHAW LIVERMORE,
Chairman, Editorial Committee



THE UNIVERSITY OF ARIZONA PRESS
TUCSON 1960

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DEDICATED TO
the men and women
who built Arizona

FOREWORD

From the time of its prehistoric peoples to its present prominence as the nation's fastest growing state, Arizona has remained a fascinating paradox, one which has challenged the imaginations of men from all levels of society and from many nations. The state's great scenic beauty and variety of climates are, of course, among its better known assets, but Arizona has many other interesting features.

The people and resources of the state are unique in many respects. Arizona's history of economic, cultural, and social development—from a forbidding frontier to a modern center of national progress in less than a century—is a remarkable chronicle of rapid achievement against difficult odds. Behind this development of recent years lies a long period of even more remarkable development by the state's earlier inhabitants, the prehistoric Indians whose descendants remain integral and important parts of the population of contemporary Arizona.

This volume is an effort by a group of specialists to outline the complex and fascinating story of the people and resources of this state, and to delineate the forces, influences, and natural phenomena that account for Arizona's growth and development. It is most fitting that this volume should be an official publication of the University of Arizona as a part of the observance of the University's Seventy-Fifth Anniversary of founding, during the period from July 1, 1959 to December 31, 1960.

In setting down an account of our state's historical development, its government, physical environment and resources, its economic, cultural, and social development, those who contributed to this volume have done much more than record the story of a dynamic state. They have recorded for posterity those qualities which are the very essence of Arizona's heritage, and this record will prove valuable not only to those seeking a better understanding of our state in present times but also to those who come along as members of future generations.

I deeply appreciate the efforts of those who prepared this valuable contribution to the history of Arizona progress. Among the many who participated, the Board of Editors and Mr. C. Zaner Leshner, general chairman of our Seventy-Fifth Anniversary program and former registrar of the University, merit special commendation for the ideas, time, and effort they have generously contributed to its conception and preparation.



Richard A. Harvill, President
The University of Arizona

Tucson
1960

acknowledgments

The making of a book of this kind involves the minds and energies of many people. The final result is an overview of a great and vigorous Western state. In the brevity of its modern history and the magnitude of its potential, Arizona is still a pioneer state. This book also is a kind of pioneer effort, to relate for the first time in one comprehensive volume, the many factors that have contributed to the making of Arizona.

Sixty-four separate essays were provided, and these form the basis for the text of this volume, and from this point of view the authors of the essays are the authors of this book. In order to attain uniformity of style and a flowing narrative, the editorial staff of the University of Arizona Press reworked some of the original contributions and therefore accepts responsibility for this volume. Acknowledgements are many. Special mention should be made of the particular contributions of Anne Merriman Peck, artist; Donald Bufkin, cartographer; Henk Moonen, photographic reproduction; Donald Sayner and Douglas Peck, design and production.

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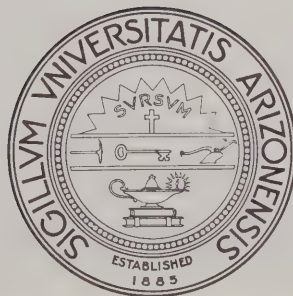
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—Chuck Abbott

..... *its people and their past*

*The true point of view in the history of
this nation is not the Atlantic coast,
it is the Great West.*

FREDERICK JACKSON TURNER

..... *the far past*

THE NATURAL FORCES THAT SHAPED THE Arizona landscape in geologic times also left a subtle imprint upon the lives of its present-day inhabitants. We see this in the occupations of the people — in mining, cattle growing, arid land agriculture, tourism, and even in the out-of-doors homelife and forms of recreation. The influences of environment were as emphatically stamped upon the lives of the native people who preceded our modern society by fifteen millenia. It is with this range of time that the archaeologist deals.

Archaeologists generally speak of large segments of the American continents as archaeological areas within which ancient societies developed and shared common ways of life. The Southwest is one of these areas, and the state of Arizona and most of New Mexico constitute its core. Parts of adjacent states to the north, west, and south are also included in this particular area (Fig. 2).

The story of man's adjustment to his environment begins with geography. Three startlingly different zones are evident in Arizona. From south to north, these are first, the flatlands of the desert, extending from sea level to almost 3,000 feet, excluding the crests of the mountain ranges. Blessed with abundant arable land, but deprived by altitude and limiting precipitation factors, this land supports little more than thorny trees, brush, and cactus. Except for a few streams and springs, surface water is scarce.

Second, diagonally from the northwest to the southeast through the state stretches a mountainous belt with an altitude varying from the upper desert limits to 12,000 feet. Surface water is abundant, stemming from generous rainfall. Forests and grass

cover the area, but good farming acreage is sparse.

The third zone is the northern plateau with an elevation of about one mile. Much of this region is barren upland, but it includes vast stretches of juniper and piñon. It is studded with colorful mesas and cut by intricate networks of canyons. Although very beautiful, the area lacks water and productive soil, two ingredients essential to prosperous living.

Each of these three land types supported and nurtured native populations before the European conquest. Nature imposed restrictions upon what could be done by a people solely dependent upon the resources of the land. Thus, to a marked extent, uniform human cultures arose in each of these zones. The sharp boundaries separating their territories disappeared only after each group had mastered its local environment. Once that was done migrations from zone to zone began.

Within the time limits of the Christian Era, therefore, the archaeologist recognizes the rise of three principal old tribal entities who left in the wake of their decline and fall hundreds of ruins broadcast over the Arizona landscape. Each distinct tribe centered in one of the three geographical areas.

Because these societies left no records from which the archaeologist can name them, the archaeologist has classified them arbitrarily. Beyond the Mogollon Rim, the northern uplands, or the Colorado Plateau, contained the Anasazi (Basketmaker-Pueblo) culture. Anasazi is a Navajo word meaning "The Ancient Ones." The Navajo Indians, recent immigrants into the Southwest, use this word when they speak of those who built and left the ruins on the lands which they now occupy.



— Tad Nichols

Fig. 1. A typical Anasazi "apartment house" — White House Ruins, Canyon de Chelly

The Mogollon people centered in the mountain belt, particularly in the eastern half. Not knowing what these people called themselves, archaeologists found it fitting to apply to them the name of an early Spanish general, also given to the Mogollon Rim in Arizona and Mogollon Mountains in New Mexico.

In the south, the earliest inhabitants of the desert area are called Hohokam, a word borrowed from the

Pima language meaning "Those Who Have Gone."

Several other groups in the northwestern quarter of Arizona have been identified by archaeologists, for example the Patayan and Sinagua. But they were of minor importance when compared with the three major ancient peoples.

No one knows when man first set foot in Arizona. By conservative reckoning, this was from 12,000 to

15,000 years ago. As archaeologists understand better the evidence they accumulate and study, this estimate for man's arrival may be pushed back in time. It is certain that the earliest Arizonans must claim kinship with the enormous reservoir of humanity in Asia. It is reasonably certain that they were attracted to this part of the world by the abundance of big game upon which their lives at that time depended — the elephants, camels, horses, sloths, and bison that lived in another geologic era. These first people were hunters, on the move, a simple folk, leaving behind only occasional traces of their presence in camp sites and in the remains of animals killed with their primitive weapons.

The bones of an elephant (Columbian Mammoth), with eight spear points in the head and rib cage, mutely evidence the hunting skill of this early man. These remains were discovered imbedded deeply in the earth along Greenbush Creek near Naco, Arizona. At the Lehner ranch near Hereford, in the San Pedro River valley, big game hunting was common. Here were found the bones of nine pachyderms, several horses, bison, and tapir, slaughtered around a water hole in a fossil stream. Spear points and stone butchering tools were uncovered at the same site. Even the remains of two fires upon which some of these animals may have been roasted were discovered. With the aid of skills developed by the geologist and the atomic physicist, particularly by the use of carbon dating, the age of the events described above has been dated back at least 11,000 years.

Evidence of these early inhabitants has also been found in Ventana Cave on the Papago Indian Reservation, 100 miles west of Tucson. Sundry stone tools, scattered bones of a variety of extinct animals, and charcoal from their fires have been unearthed beneath fifteen feet of refuse — the accumulation of centuries of debris left by later occupants.

These archaeological discoveries illuminate the first chapter of Arizona's history. They are preserved in the excellent exhibits of the Arizona State Museum at the University of Arizona.

What we know of man in Arizona from this point on is related to the disappearance of the animals upon which, at that time, he subsisted. The climate, fauna, and flora of those days were much different. With the glacial retreat of the last Ice Age came the end of big game. But man's hunting skill also hastened the doom of the animal herds. When man was deprived of his primary food source, he was

forced to adjust to other foods or to perish.

The Cochise people form the next connecting link in man's early history. Their record stretches over at least 8,000 years. They are sandwiched, therefore, between the elephant hunters and the more highly developed people of the Christian Era. Archaeologists have named these people after Cochise County, where many traces of them were first found in the alluvial valley deposits brought to view by the heavy arroyo cutting which began in the last decades of the nineteenth century.

While the earliest of these Cochise people knew and hunted the extinct animals, the loss of the big game forced them to turn to smaller quarry, the species of animals we know today. They also turned to a greater dependence upon plant foods. Thus, they became gatherers primarily, demonstrating their capacity to adjust to a changing environment. They developed appropriate stone tools for collecting and preparing vegetal foods. Camp sites of this period have produced large quantities of such tools. Among these, and undoubtedly the most important, was the functionally related pair of grinding stones consisting of the nether stationary unit against whose surface the movable hand-held stone was operated. This was the prototype of the mano and metate associated with the farming societies of later times.

Until approximately 2,000 B.C., the Cochise people collected foods provided by nature. At that time, or thereabouts, a cereal grain in the early stages of domestication came to them by way of the people in Mexico. This grain was a primitive form of corn, or maize, in which each kernel was separately sheathed in a husk and attached to a small cob. The introduction of this new food changed man into a planter and food producer, for corn does not reseed itself, but must be planted and tended. This was a revolution of major proportion in Southwestern culture history. To some extent, man could now begin to control his environment. He could produce more than he could consume. But the capacity to store the surplus food was essential to the success of the system. It took some time for the widespread adoption of corn, but by the beginning of the Christian Era, most of the people in the Southwest were well on their way to a sedentary agricultural life.

About this time, two other vegetal plants, squash and beans, were introduced to enrich and stabilize the economy. It is at this point that archaeologists begin to use the regional tribal distinctions associated with the three physiographic provinces of Arizona.

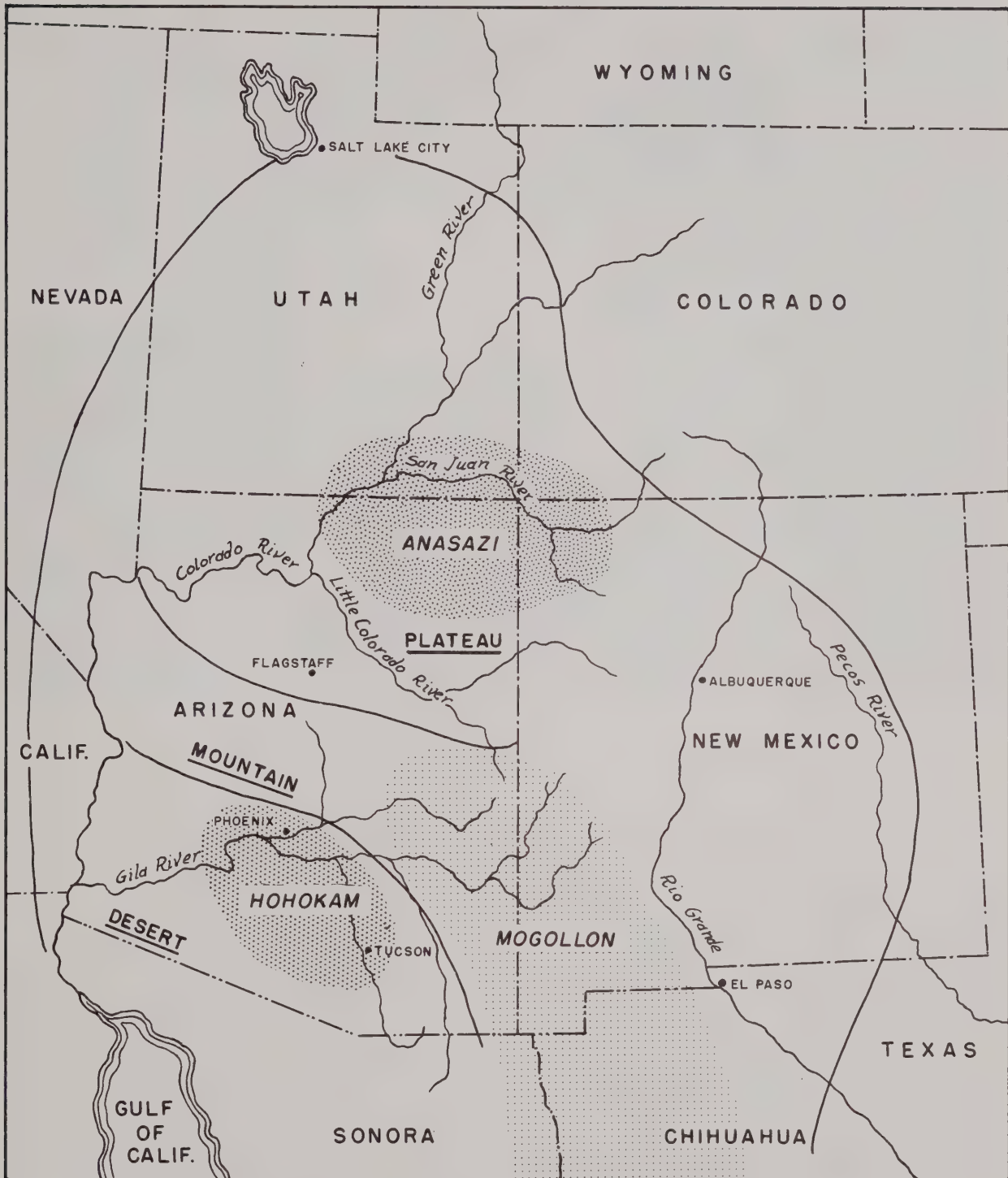


Fig. 2. Approximate location of the three principal culture centers at about 700 A.D.

The respective histories of these three tribal groups can be traced through their artifacts with increasing reliability and completeness to the present.

The Hohokam, the Mogollon, and the Anasazi experienced special problems in dealing with their environments—the desert, the mountain zone, and



Fig. 3. Hohokam pottery is distinguished by its shapes, designs, and red-on-buff color

the plateau, respectively. But of these problems, water was primary. Where to find it, how to use and control it for the benefit of all was difficult. A second major problem was obtaining food, both in collection and in production. They had to coax crops from an unyielding soil and they were handicapped by contrary elements of nature. A third difficulty was found in living from day-to-day. They were forced to develop smoothly-operating social, political, and religious systems. While the three groups shared numerous traits, their differences distinguish them from one another. Although their respective and specific origins are unknown, surely their roots dip back into the culture of the old Cochise people. Archaeologists can only guess tentatively what languages they spoke. It appears certain, however, that all three groups were stimulated to a higher living standard by the introduction of the new crops, the new agricultural practices, and the new arts, such as pottery—probably borrowed from Mexico whose culture appears to have been more advanced.

It was the Hohokam who built the irrigation canals that drew water from living streams to divert it to thirsty fields far distant from the source. Several hundred miles of such engineering projects have been traced in the Salt and Gila River valleys. Some of those canals match modern ones in size. In fact, in pioneering days, a few of the Hohokam ditches were restored to use by cleaning them out, patching breaks in the banks, and turning water into them. No Indian achievement north of Mexico, in pre-Conquest times, surpasses the Hohokam canal system for planning, expenditure of effort, and for the evident inter-community organization that produced them. They were master-farmers, producing corn, beans, squash, and cotton in an arid land by irrigation and water control. Some form of canal irrigation may have existed by 500 A.D., but the system reached its height between 1000 and 1400.

By developing such an intricate system of canals, the Hohokam accomplished another important objective: they had freedom of choice for the location

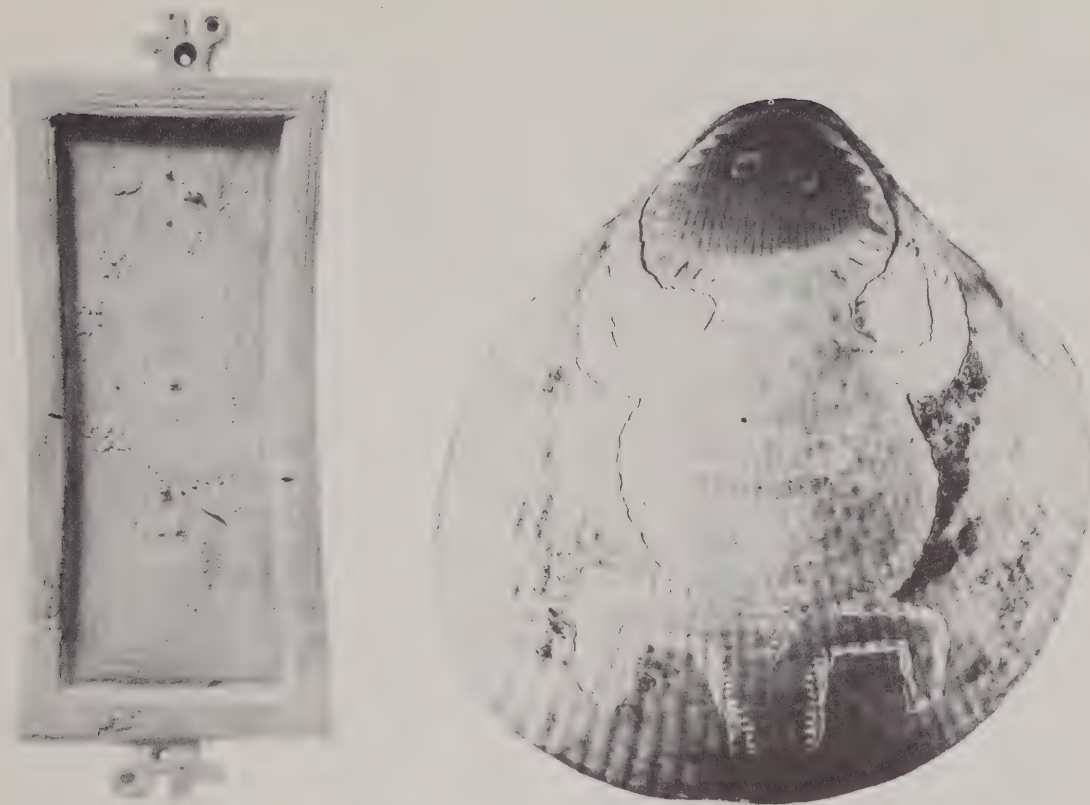


Fig. 4. Hohokam carved slate palette and a sea-shell with design done by acid etching

of their villages. Ordinarily the village or town site was picked because of the existence of natural water. But canals, going far from streams, opened new possibilities of mobility and location—the kind of emancipation from the environment achieved in our society often only by digging wells. The classic example of this mobility of location, dating from the canal period, was the large settlement of Los Muertos, six miles south of Tempe, excavated by Frank Hamilton Cushing in 1887–88. There, hundreds of people lived in the desert, six miles from Salt River, sustained by the thin lifeline of a canal. No other prehistoric people in the Southwest matched this feat. From this fact the archaeologist deduces the existence of a political and social organization that had community welfare at heart.

Some of the desert dwellers, such as those living in what is now the Papago Reservation, were not fortunate enough to have access to live streams. Here control of the surface runoff was the key to successful living. Gathering ditches were one answer. One of these ran in a westerly direction for nearly ten miles from the base of Baboquivari Peak. It cut across numerous small natural drainages on the

gentle piedmont slope, collecting the rain water and directing it to fertile ground in the lowland. This was a precarious form of irrigation, but it must have worked at least much of the time.

Archaeologists still do not know whether the knowledge of irrigation and other farming techniques spread to the Arizona Indians at the time they received the first seeds for planting from Mexico. Undoubtedly it did, but it remained for the genius of the Hohokam farmers to modify the principles learned through oral communication to meet the demands of the local environment. To many people, the Hohokam, more than any other group of prehistoric Southwesterners, exemplify man's capacity to rise to the challenge of a harsh environment by understanding it and by turning its hidden advantages to his favor, thereby setting the stage for the development of what we choose to call civilization.

As it did on all other farming people, the miracle of agriculture left a deep imprint on Hohokam society. The growing season of plants, and labor investments in canals and fields anchored the people to the soil. This meant permanent villages in which the labors of a few could produce food for many.

Food surpluses permitted the release of time and energy for other pursuits which contributed to the advance of Hohokam culture.

Impressive and solidly constructed domestic and religious architecture was not among the great Hohokam achievements. For more than a thousand years the family home was a roofed-over pit in the ground, looking like an earthen mound from the outside. With a side entrance, the inside was comfortable in both summer and winter, an efficient shade in spite of its simplicity. Until recently, archaeologists had not found any architectural remains that might be construed as primarily for religious observances. The kiva, either large or small, a common feature in Mogollon and Anasazi ruins, was apparently entirely lacking. But in 1958, scientists from the Arizona State Museum cleared the debris away from an earthen mound situated near Gila Bend, disclosing a flat-topped, pyramidal temple base. The age of this structure was close to 1100 A.D., and it is one of the many links that relate the Hohokam to the high civilizations of central Mexico.

Another prominent feature in some Hohokam sites is the ball court, in which the Indians played a game doubtless similar to that for which the stone-walled courts found in Toltec and Maya ruins were used. An old ball made of native rubber, found in a pottery jar near Casa Grande, hints that balls of this kind were used in the game. As in Mexico, there were probably religious aspects to the game, but of these nothing is known. The evidence suggests that the ball game was played in special arenas as early as A.D. 700 and that the custom persisted at least until 1400. During this period there was a reduction in the length of the court, and a shift in orientation from east-west to north-south. It is probable that the kickball races of the Pima and Papago Indians represent a faint echo and survival of the early formalized game.

The effect of a sedentary farming life on the Hohokam is best seen in their arts and crafts. As the original Arizona cotton growers, a plant that came to them from Mexico, perhaps before 700 A.D., the Hohokam also became producers of fine textiles. The unfortunate custom of cremating the dead, with their finery, has destroyed many of the products of the loom, but scraps have survived in a few rock shelters, such as Ventana Cave, where the Hohokam once lived. From these scraps it is evident that, in addition to the simple weaving of cloth, a number of complicated techniques were

used. Tapestry, twill, gauze, and an ingenious lace-like cloth known as weft-warp openwork provided means for decorating cloth. Evidence of these is found among the neighbors of the Hohokam to the north and east, who obviously were inspired by Hohokam achievement, and many of whom were almost certainly supplied with raw cotton from Hohokam fields through trade.

In terms of quality, Hohokam pottery was not of the best. But what it lacked in quality of body it made up for in form and design. Shapes run a wide gamut from the conventional to the eccentric (Fig. 3) and some of these, such as the legged vessels, also suggest affinities with the people of Mexico. The buff-colored pottery was painted with a red-brown iron oxide pigment, producing what the archaeologist calls red-on-buff of various kinds. This pottery is readily distinguishable from that of other Southwestern people. Most characteristic of the designs were repeated life forms which, with a few cursive brush strokes and without detail, achieved an amazing degree of animation. Careful stratigraphic studies at Snaketown on the Pima Reservation and in other ruins has traced at least 1,500 years of Hohokam pottery history.

The Hohokam talent for modeling clay is best revealed in the figurines which usually copied human form. The occurrence of many of these with the cremated dead suggests ritual use. In some instances it appears that efforts were made to capture the personality of a real person.

Stone sculpture was also an outstanding Hohokam trait, best exemplified by slate palettes for mixing pigments and small receptacles with bas-relief decoration. Sculpture was limited to small objects, differing in this respect from the monumental works of the Mexican Indians.

Because the Hohokam were nearer to the sea than any other Southwestern Indians, they found sea shell to be a material which could readily be fashioned into a large variety of ornaments. They excelled all Indians north of Mexico in this art, and capitalized upon their ability to acquire shell easily by trading it, both raw and shaped, to tribes far and near. Their crowning achievement was the development of an etching technique, whereby a pattern was obtained by immersing a shell painted with a wax in an acid which was probably the fermented juice of the saguaro fruit (Fig. 4). This technique was apparently unique to the Hohokam and was invented by them by 1100 A.D., some 400 years before the

same principle was employed in Europe by craftsmen to decorate metal armor.

The custom of cremating the dead began in the Southwest long before the time of Christ. The incinerated bones of the deceased were generally enshrined in earthenware pots, sometimes with lavish accompaniments. Only those which resisted fire, such as objects of stone, bone, and shell survived, but fragments of cloth and other perishable objects are occasionally found among the ashes. The loss of these objects, as well as the destruction of the physical remains of the people by fire, has seriously limited the archaeologist's ability to write as fully as he would like about all the aspects of the Hohokam people and their culture.

Particularly important is the role the Hohokam played as the recipients and modifiers of the elements of high Mexican civilizations. Of all Southwestern people, they mirrored the achievements of Mexico most clearly, accepting what they wanted and changing it to fit their situation. The direct import of a few things, such as copper bells and pyrite-encrusted mosaic plaques, is evidence of trade contacts. The archaeologists see the Hohokam not as immigrants themselves, but as people with roots in the old Cochise culture, who locally evolved one of the most fascinating early societies by an imaginative combination of native and imported ideas.

By 1400 A.D. the Hohokam went into an eclipse as a virile group. Throughout the Southwest, this was a period of drastic changes, which caused the decline of other groups as well as the Hohokam. Paradoxically, archaeologists know less about the period between 1400 and 1700 A.D. than about the culture history of the millenium before 1400, but there are reasons for believing that the Pima and Papago Indians are the modern descendants of the Hohokam.

Standing in sharp contrast to the Hohokam were the mountain-dwelling Mogollon people. By comparison they were a drab people, their culture more difficult to define, their contributions to the total culture history of the Southwest undistinguished. They inhabited the Arizona-New Mexico border country south of the White Mountains, stretching down into Mexico for an undetermined distance (Fig. 2). While there is some dispute over the origin of the Mogollon, the evidence seems clear that their roots are in the Cochise culture. The mountains gave them ready access to water and plentiful game, but little land for farming save in a few favored localities.

Like that of many forest inhabitants, their life was simple, a response to environmental limitations.

Yet they were among the earliest Southwestern people to grow corn and to make pottery. At first this was unpainted. Later, it was decorated with red-earth pigments on a brown base. Superficially this resembled the pottery of the Hohokam, a likeness born of the common inspiration for both traditions from Mexico, but tribal distinctiveness is disclosed by the difference in the method of manufacture and the surface treatment. The introduction of pottery-making may be dated to the first or second century B.C., long before the art was learned by the Anasazi, their neighbors to the north. Corn reached them somewhat earlier than this.

Mogollon villages consisted of loosely arranged clusters of houses, partly underground and partly above, entered by means of covered ramps leading to floor level from the east. The idea of building walls of stone was foreign to them until late in their history. In most villages a large pit structure, much larger than those designed for family living, has been found. This is believed to have been a building for community ceremonial use. It is a reminder that, despite a simple and rigorous existence, the social, political, and religious aspects of Mogollon life may have been complex.

The material goods of the culture not destroyed by time and soil were mostly rough tools of stone, tips for arrows, metates for grinding corn, thin rock slabs for tilling the soil, grooved mauls for work requiring heavy blows, small stone bowls for pulverizing pigments, and similar items. The Mogollon excelled at producing the tubular stone pipe, technically the most difficult to make. A few simple bone tools were also used, and gambling pieces of the same material reveal at least one of their diversions. They knew the art of basketry and in late times, after A.D. 700, they wore cloth of cotton, a fiber almost surely imported from the Hohokam.

The Mogollon Indian was of medium build and stature, with a round head, not greatly different from many modern Indians. He wore few, if any ornaments, though he may have painted his body to offset this lack. At death he was tightly folded and placed in a shallow pit and rarely accorded the luxury of accompanying food containers or tools.

Since the northern frontier of the Mogollon touched on the Anasazi, and beyond the western boundary was the Hohokam domain, cultural blending was inevitable, especially because the Mogollon



Fig. 5. Pottery of the Anasazi of different ages from about 600 to 1300 A.D.

were a culturally impoverished lot and their neighbors were not. The net result of this was a submergence of the old simple Mogollon way of life, and the rise of a more complex society basically Anasazi, also tinged with Hohokam, in which a few old Mogollon elements were retained. Archaeologists are greatly interested in a cultural transformation of this kind because it reveals some of the processes of change. Although the Mogollon left an undistinguished record, having given little to their neighbors but having received much more, they added special and challenging problems to the archaeological past. Their modern descendants, if any, have not been identified.

On the plateau to the north of the Mogollon was the homeland of the Anasazi (Fig. 2). These people are best known of all prehistoric Southwesterners because archaeologists have studied their ruins for nearly a century and because, until recent years, most expeditions focused their attention on this tribe. Furthermore, the Anasazi have received prominence through the designation of many of their abandoned homes as National Monuments.

Much of the plateau is arid, and vast stretches have neither arable land nor readily accessible sur-

face water. These two factors determined the deployment of the population, and because of these the population density was spotty over the plateau, varying from great centers such as Black Mesa and the Hopi country, the White Mountains, Mesa Verde, and Chaco Canyon, to the sparsely inhabited Painted Desert. The diversified environment of the plateau required the development of specialized techniques before the land could be made to produce foodstuffs in sufficient quantities to support towns. The Anasazi rose to this challenge with an amazing degree of skill. The compelling requisites of water and soil determined the extent to which a community could expand, and expansion was the tribal pattern, demanded by defense, group activities in farming, and proper conduct of religious ceremonies.

The Four Corners country, where Arizona, New Mexico, Colorado, and Utah come together, is generally regarded as the heartland of the Anasazi, and it is here that their oldest remains are found. These date from about the beginning of the Christian Era. Prior to this time the Anasazi were probably a nomadic people, but the earliest archaeological evidence is from the time when they were just adopting agriculture. Within a few centuries their

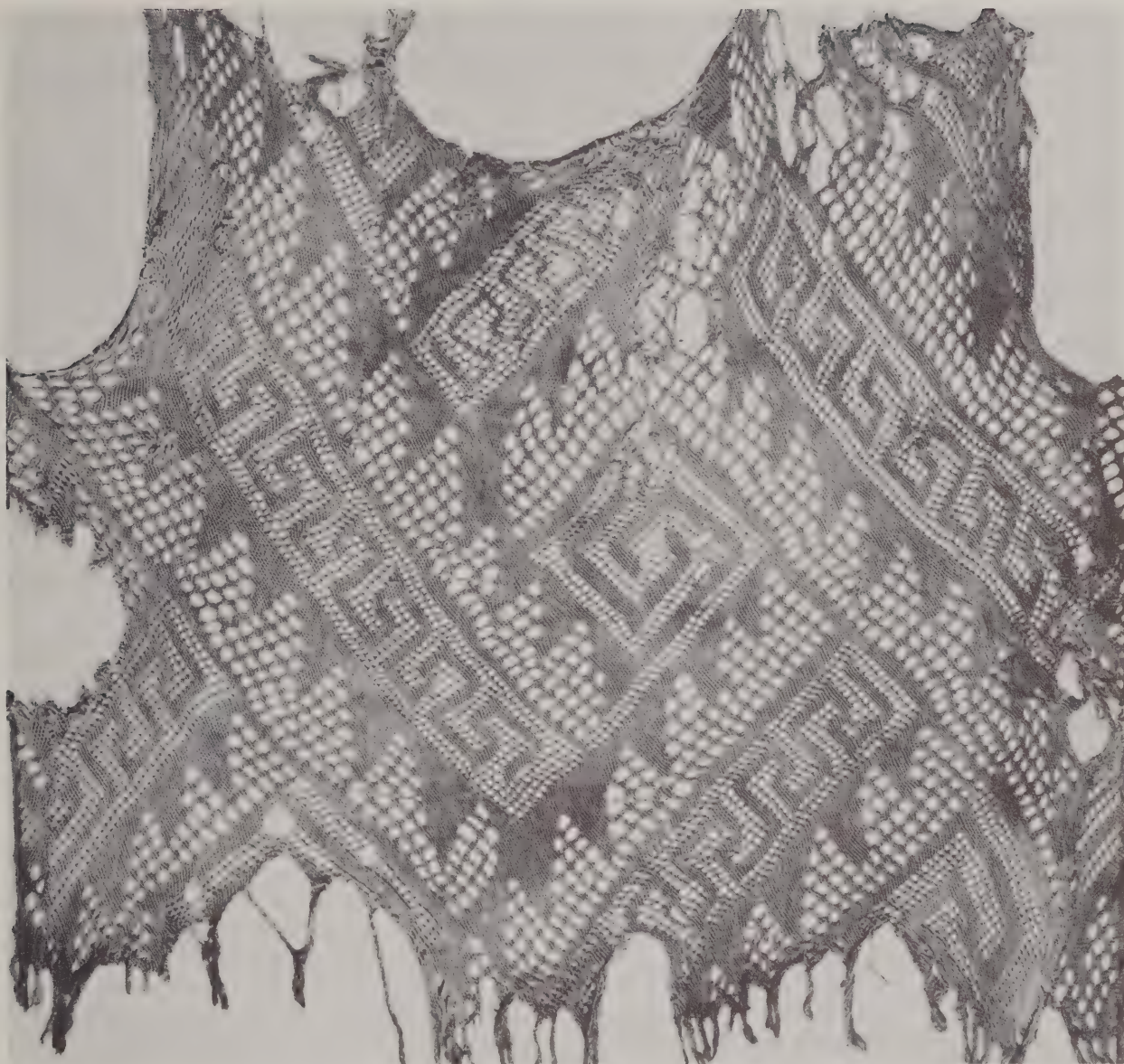


Fig. 6. Fancy lace shirt of cotton from Upper Tonto Cliff Ruin. Age: 14th century

living pattern was established. Their permanent dwellings, in or out of caves, resembled those of the Hohokam and Mogollon; these were often clustered in loose village arrangements. The bow and arrow replaced the spear-thrower or *atl-atl*, and pottery-making and the bean were added to the culture. Skills of the artisan were developed in basketry, and in the creation of woven sandals and sashes. Even music made its appearance with the development of flutes. The dog was domesticated. All this represents great progress by the Anasazi people in adaptation to and control over the environment.

Then started a long upward climb, the molding of a new way of life a thousand years in the making. These steps are traceable in the thousands of ruins that dot the plateau. The climax of Anasazi achievements was from about 1000 to 1400 A.D. This was the time when the homes were often built in caves widely scattered through the canyons that crease the plateau (Fig. 1). But infinitely more pueblos, as Anasazi towns are known, were built in the open because there simply were not enough caves to supply natural shelter for all. It is incorrect, therefore, to think of Anasazi people as cliff-dwellers

only. They established their residence wherever land and water permitted, and if a cave was available, so much the better.

Due to a method of dating which was developed on the University of Arizona campus, archaeologists can speak of the age of Anasazi remains with a definiteness not possible for any other New World ruins. Dendrochronology, or the study of tree-rings, as applied to the ruins of the Southwest, was the brain-child of Dr. A. E. Douglass. The timbers that went into the Anasazi residences are the main sources for the raw data upon which this system depends. When the archaeologist is able to refer to past events in terms of dated decades, quarter or half centuries, rather than in the vagueness of a relative chronology lacking calendar years as we know them, half of the battle to interpret prehistory is won. The Anasazi story has been enormously enriched because of this method of studying the past.

With the mastery of agricultural techniques, food surpluses followed. The ability to store excess food in jars, baskets, and bins, even to the point of tiding the people over lean years, provided the stability that resulted in an expanding population, large communities, specialization in the arts, and inferentially, increasing complexity in the social, religious, and political systems.

The evolution of pueblo architecture from simple beginnings was one of the finest accomplishments of the Anasazi. The joining of room to room whether of stone or adobe, and the stacking of rooms to a height of four or five stories was the Anasazi method for packing people into the least possible space. The reason for this crowding is not clear since there was no shortage of land. While most towns grew by accretion in response to the expanding population, a few of them show planning as though following an architect's design. The monotony of solid room blocks was broken by plazas, providing easier access to the rooms and good space for outdoor activities. The plazas of our oldest Western towns are surely traceable to this old Indian custom.

Another noteworthy architectural feature was the underground kiva with specialized furnishings. As in the modern pueblo Indian villages where kivas are in use today, the prehistoric kivas were probably owned by the male members of the clans, and were used both as club houses and for secret religious rites. The great kivas, as much as seventy feet in diameter and strongly rooted, were the most impressive buildings ever erected in the Southwest until

the Conquest. They served the larger communities as a place where rites vital to the group as a whole, such as rain-producing ceremonies, were performed.

A familiar sight on all Anasazi ruins of this climax period are the numerous fragments of pottery. Much of this has a white background, one of the most distinctive of all Anasazi hallmarks (Fig. 5). Many other kinds are also present, such as multi-colored pottery and the rough-surfaced cooking and storing pottery known as corrugated. All of these have special significance to the archaeologist because the shapes, colors, and designs show differences from place to place and time to time. Pottery, therefore, is a hallmark to time and people.

Other arts also reached a high level of perfection. Textiles of cotton (Fig. 6), robes of feather cloth, sandals in a great variety of weaves, baskets, personal ornaments, ritual finery — all these have been found by archaeologists.

The Anasazi dead were normally buried in the refuse heaps. From the graves come many of the objects that help archaeologists characterize the society. The skeletons reveal that these Indians have living descendants among such tribes as the Hopi, Zuñi, and the Rio Grande Pueblos of New Mexico.

By 1400 A.D. some of the larger centers, thriving only one to two centuries before, had already been abandoned. The frontiers were shifting, mainly to the south out of the Four Corners country. The reasons for this still puzzle archaeologists. No satisfactory answer has yet been discovered. Certain it is that the causes were complex, interlocking, and influenced most of the Southwest.

This movement of people resulted in even larger centers than before, but far fewer in number. These enjoyed a brief spurt of cultural energy. By 1500, however, only the Hopi, Zuñi, and Rio Grande centers remained. Chroniclers of the Spanish Conquest, which began in 1540, record only seventy pueblo towns, and by then most of the old glory was lost. The number today stands at about twenty-six. Perhaps a factor in the concentration of the Anasazi during the fifteenth and sixteenth centuries was the arrival of wandering hunters, the Navajo and Apache Indians. Upsetting as their presence must have been, these nomads did no more than speed up the Anasazi decline; they did not initiate it.

Anasazi history, as that of the Hohokam, matches the world-wide pattern of the rise and fall of ancient societies. Though obscured by time, their achievements have lent drama to Arizona's past.

..... *the Spanish past*

"AWAY UP HERE IN THE FAR NORTH, THOUSANDS of miles from Spanish centers at Mexico City, Guatemala, Bogotá, Santiago, and Buenos Aires, lay the outer fringes of the Spanish Empire — the northern borderlands. Remote they were, indeed, but what a history they have had!" Thus writes the Southwest's most distinguished historian, Herbert E. Bolton, in a panoramic presentation of Southwestern exploration called *Outpost of Empire*.

His exclamatory remark, "What a history they have had!" stemmed partly from his profound knowledge of the history of Arizona, which, for the greater part of 300 years, was one of Spain's most outlandish frontiers; and for twenty-five years, from 1821 to 1846, it was Mexico's most isolated political entity. But outlandish and isolated as it was, it was the home of scores of Indian tribes, and by the middle of the nineteenth century it was to be a meeting place of two Old World cultures, Spanish and Anglo, not to mention a few German and Italian culture bearers who served as missionaries during the seventeenth and eighteenth centuries. Some came to seek precious metals or to husband the land, while others came to garner souls or to explore or to seek military and political glory.

The recorded history of Arizona began on a June day in 1527, when 600 men in five ships left Sanlúcar, Spain, "to conquer, occupy, and colonize 'the provinces of Florida,'" which then constituted the Gulf of Mexico coastal areas from the tip of the Florida peninsula to the Rio Grande. This was to be the ill-fated Narváez expedition. On board were Alvar Nuñez Cabeza de Vaca, the treasurer of the enterprise, together with Alonso del Castillo,

Andrés Dorantes, and the Negro slave Estevanico. These, according to some authorities, are said to have been the first Europeans to reach Arizona.

About a year later, after re-outfitting in Española (Haiti) and Cuba, the expedition made a landfall near Tampa Bay; and thus was begun one of the Southwest's most tragic ventures. Hostile Indians, lack of sufficient supplies, and a storm which sent the greater part of the expedition's fleet to the bottom of the Gulf took the lives of the greater part of Narváez's army. Four of the survivors, Cabeza de Vaca, Castillo, Dorantes, and Estevanico were to be held captive by Texas Indians for six years, while a fifth, Juan Ortiz, was to live with the Florida Indians for ten years before being rescued by Hernando de Soto.

These six years of captivity of Cabeza de Vaca and his companions were hard years; but they were profitable years, for Cabeza de Vaca gained an insight into the habits of the natives which enabled him, as a medicine man, to travel westward from tribe to tribe as a welcome healer. His route through Texas and New Mexico need not concern us here. Of more immediate importance is whether he and his three companions were the first Europeans to reach Arizona. If so, what route did they follow?

Investigators of this rather troublesome problem are not in agreement. About half of them maintain that Cabeza de Vaca did not enter Arizona, while one extremist is sure that Narváez's treasurer crossed into Arizona by way of Zuñi. Another has the courage to say that all four of the survivors made their way across the lower San Pedro River and thence west into the Santa Cruz Valley. Two students of

the matter, Carl O. Sauer and Cleve Hallenbeck, without doubt the most careful investigators of the entire Cabeza de Vaca route, are authorities for the statement that the three Spaniards and the Negro slave stepped into the southwestern corner of the state near Indian Wells. From this point, according to Sauer and Hallenbeck, Cabeza de Vaca followed a course by way of Tule Springs and over the low Peloncillo Mountains into the San Simón Valley, thence southwest across the valley through the pass between Dos Cabezas and the Chiricahua Mountains. The route is further marked out as proceeding along the western slopes of the Chiricahua Mountains, and then following a somewhat vaguely-defined course to San Bernardino Valley. And quite as vague at this point is the matter of chronology. When did Cabeza de Vaca reach Arizona? Late in 1535? Early in 1536? A conservative and safe guess is that it was early in 1536. At any rate it is known that he completed his overland journey at Culiacán, Sinaloa, on April 11 of the latter year.

Cabeza de Vaca may have been a marathon hero to his countrymen, but of far more importance to them than admiration of his endurance was what he had to say about the marvels of the north. For example, when he told them he had reason to believe there were large and rich cities in the region, word soon got around that this must be another Mexico, another kingdom of the Aztecs. Or perhaps these were the long-lost Seven Cities, a fable as old as medieval Spain. In any event, it was a matter worth looking into. Even cautious and stolid Viceroy Mendoza was willing to spend the king's money on an army which he would send north in search of these reportedly rich cities.

But there must first be a reconnaissance expedition. Who would be in charge of it? Not Cabeza de Vaca, for he was to return to Spain and then later go off to Paraguay for more high adventure. Nor could the viceroy persuade either Castillo or Dorantes to retrace their steps up the Pacific coast; but perhaps the viceroy might wish to buy Estevanico, the Negro slave. Mendoza saw the wisdom of this, purchased the slave, and scoured the Valley of Mexico for an experienced and literate man who would lead the expedition and use Estevanico as a guide.

Someone now suggested the name of Friar Marcos de Niza as the most suitable person to take charge of the reconnaissance expedition, for it was known that he had had an enviable reputation as

an explorer in both South and Central America. Moreover, he was at the present moment in Mexico City. Mendoza responded favorably to the suggestion and offered the job to the friar, who promptly accepted the assignment.

The details of Friar Marcos' route are shrouded in mystery. He and a few Indian guides left Culiacán in March, 1539, followed a trail blazed by Estevanico, who had been sent ahead with instructions to keep the missionary advised on the character of the country. The slave sent back tales of the marvelous splendor of the great cities which he had discovered, but aside from the fact that is pretty well established that he approached the present international boundary line from the upper Sonora River, it is not at all clear whether he continued on north to the Zuñi pueblos by way of the San Pedro or through the San Simón Valley. And there are some who even doubt that Marcos entered Arizona. This, however, is an extreme point of view, as is the remark that the good friar wrote his name on some rocks near present-day Phoenix. The conservative point of view, and one held by most historians today, grants that Marcos barely crossed into Arizona near Lochiel. And somewhere in this region he learned that the Indians had killed Estevanico, which seems to have occasioned Marcos' rapid retreat to Culiacán.

Of immediate importance, as was the case with Cabeza de Vaca's observations, was what Marcos had to say about the people in the far north, and not about whether he had entered this or that river valley. So when Marcos said that he had seen one of the Seven Cities, Cíbola, "larger than the city of Mexico," with portals of turquoise, Viceroy Mendoza promptly organized an army to take possession of what appeared to be another Tenochtitlán, or Mexico City.

Command of the army was given to Mendoza's young friend, Vásquez de Coronado, who had only recently been appointed governor of Nueva Galicia, a vast west-coast province extending indefinitely northward from about present-day Guadalajara. Young men eager for adventure and possible wealth hastened to join Coronado's army, which was to consist of 336 men; and Friar Marcos, now Franciscan provincial, went along as guide and carried instructions to lay the foundation for future missionary work on this distant frontier. Also, a few of the soldiers' wives were permitted to join the expedition, and several hundred Indians were sent as servants

and herdsmen. The herdsmen must have been busy indeed, for there were at least fifteen hundred animals in the caravan, including horses, cattle, rams, and sheep. Castañeda, one of Coronado's lieutenants, places the figure as high as sixty-five hundred!

Final preparations for the expedition were made at Compostela, capital of Nueva Galicia, and on February 23, 1540, the army began its march northward. Culiacán, the farthest northern outpost of Nueva Galicia, was reached early in April. Here Coronado pondered a statement he had recently received from Melchior Díaz, the *alcalde mayor* of Culiacán, who in the previous November had been sent by Mendoza "to go with some mounted men and to see if what he might discover conformed to the report of Father Fray Marcos."

Díaz, with fifteen horsemen and a band of Indians, had made a round trip to the north which lasted for about four months. They are known to have reached the Sonora, San Pedro, and Arivaipa valleys and to have gone as far north as Chichilticale near the Pinaleno Mountains. What is not known, however, is the precise location of Chichilticale, or Red House, supposedly to have stood at the foot of these mountains. Bolton places it on 76 Ranch near Eagle Pass, where "there are extensive pueblo ruins, one of which may well be the remains of the structure . . . called Chichilti-cale."

In Díaz statement to Coronado the elusive site is mentioned, but Coronado was more interested in what the *alcalde* had to say about Indians and cities than about archaeological sites. In the main, though somewhat less dramatic in the telling, Díaz corroborated the essentials of Friar Marcos' report. Díaz makes no claim to having seen the cities, but his native informants assured him that "there are seven villages," that "the whole group is called Cíbola," that "they have plenty of maize, beans, and melons," and that "they do have turquoises in quantity."

There was no turning back now, even though Díaz' account of the fabulous north was a pale image of the Franciscan's report. But, owing to the barrenness of the route which Díaz said the army would have to follow, Coronado reorganized his expedition into two contingents. One of these, a select group of about one hundred soldiers and all the friars, was to serve as a vanguard under the command of Coronado. The other and larger part of the army was to remain at Culiacán under the direction of Tristán de Arellano with orders to follow the general in a fortnight.

On April 22 Coronado set out with his vanguard, following a route which had been marked out by Díaz and Marcos through the Sonora Valley and down the San Pedro to a point just below Benson. It was now July, and the natives appeared to be friendly, especially the Sobaipuris, who lived on the San Pedro, or Nexpa as the Indians called it. Coronado's army now marched a little east of north through Galiuro Range and across Arivaipa Valley to Eagle Pass. Here again the records speak of the Red House, which, writes Castañeda, "must have been despoiled by the natives of this region, who are the most barbarous people thus far encountered." But this did not discourage Coronado from asking the natives if they could tell him how far it was to the Western Sea. "I found that I was fifteen days' journey distant from the sea, although the father provincial had said that it was only five leagues distant and that he had seen it. We all felt great anxiety and dismay to see that everything was the opposite of what he had told your Lordship."

Coronado's interest in the Western Sea did not arise from idle curiosity: the viceroy was sending three ships up the Gulf of California coast with needed supplies for the army. The captain of the flotilla, Hernando de Alarcón, would certainly find it a bit difficult to deliver his cargo to a point some two hundred miles inland. "Great anxiety and dismay," indeed!

Alarcón's vessels had left the port of Culiacán shortly after the departure of Coronado's army, including the contingent under Arellano. The voyage was slow, but finally, on August 26, the fleet sailed into the shallow waters at the head of the Gulf. A few days later the ships reached "a mighty river with so furious a current that we could scarcely sail against it." They had discovered the Colorado River, which Alarcón chose to call the Buena Guía, or Good Guide, a phrase that appears on the motto of the coat of arms of Mendoza.

In order to make better headway against the turbulent stream and not to be wrecked on sand bars, Alarcón anchored his ships near the mouth of the river and proceeded upstream with two launches and twenty men. But the going was still most difficult, and at times it was necessary for the crews to fasten ropes to their boats and pull their crafts up the river. Nor did the Indians contribute to the peace of mind. About "two hundred and fifty Indians in warlike mood . . . came toward us with a loud outcry, their bows and arrows ready." But

Alarcón was an able diplomat; before many days had passed the Indians were assisting the Spaniards in their struggle against the current and bringing "so much food that we had to lighten our boats twice." Moreover, the Indians were duly impressed with Alarcón's insistence that he was the Son of the Sun!

Where was Coronado's army? All the way up the Gulf, Alarcón had sought in vain for news of the general. But now the natives of the Colorado had encouraging words for Alarcón. One Indian told him that "he had been in Cíbola, that it was one month's travel from his country," and that he had obtained a "dog and other articles from a bearded negro . . . He had heard that the chieftain ordered him killed." Others, too, had heard of Cíbola, and some said they had learned of Coronado's arrival there. This set things in motion. Alarcón promptly called for volunteers to take a message to Coronado. But no one, either Spaniard or Indian, accepted the exciting challenge to carry the message to Cíbola.

Somewhat displeased with his failure to contact Coronado, Alarcón prepared to retrace his course, but only after he had reached a point on the Colorado just above the Colorado-Gila junction. Yet there remained one final, desperate effort to get in touch with Coronado: the captain sat down and wrote letters summarizing his experiences, then buried the letters at the foot of a tree on which he incised, "Alarcón came this far; there are letters at the foot of this tree." Alarcón now set his sails to a friendly wind which sent his ships to the sheltered ports of Nueva Galicia.

While Alarcón was exploring the Colorado and Coronado was drawing near to Cíbola, the main army under Arellano had bivouacked in the Sonora Valley to await further orders from the general. This gave Arellano the opportunity to send a party of his men to the Gulf in search of the sea expedition. The ships were nowhere in sight, but there were plenty of tall Indians. One "was so large that the biggest man in the army did not come up to his chest." This special detail returned to the Sonora Valley in time to learn that orders had come from the north with instructions to proceed at once, but to leave a small contingent in the valley as a sort of half-way base. The couriers who delivered the orders were none other than Friar Marcos and Melchior Díaz. The Franciscan, in poor health and no longer in the confidence of Coronado, was encouraged to return to his duties in Mexico. Díaz was commissioned to take charge of those who would remain

behind in the valley, and also to search for the elusive ships of Alarcón.

Shortly after Arellano moved to join Coronado, Díaz began his memorable march west through the land of the Papagos and the Yumas. With him went twenty-five Spaniards and several Indians as servants, guides and interpreters, and a herd of sheep was driven along for food. It was late September, and the route was northwest, perhaps on one of the Southwest's most perilous trails, the Devil's Highway. Details of the journey are not known, for it appears that none of the participants in this hazardous venture wrote of their experiences. Fortunately, however, the garrulous Castañeda was close enough to the event to provide us with a reasonably accurate synopsis of what occurred.

After a march of 150 leagues, Díaz reached the Colorado near the mouth of the Gila, where the inhabitants were "like giants, exceedingly tall and muscular." The Spaniards also noted that the Indians carried firebrands with which they warmed their hands and bodies; and for want of a better name, the soldiers called the Colorado the Río del Tizón, or Firebrand River, a name which was more commonly applied to the river than Alarcón's Buena Guía.

Of course Alarcón was not to be found, but the Yumas told him that the Son of the Sun had only a few weeks earlier turned down the river. In post-haste Díaz and his men went in search of the captain. Three days later they reached a place about half way from the Gulf to Yuma, and, behold! here was the tree at whose foot lay the buried letters. They were promptly dug up and read. Castañeda does not provide us with any quotations from the letters, but he does say that the letters made it clear to Díaz that Alarcón had returned to New Spain, or Mexico. What a treasure it would be if these letters were extant! Perhaps Díaz destroyed them in a rage of disappointment.

Díaz retraced his steps to the vicinity of Yuma, where, after a brush with the Indians, he and his party crossed to the east bank of the river. Then, swinging south and west, the group went in search of the "other coast," which apparently meant the western shore of the Gulf. After about a week's march, tragedy struck when Díaz was accidentally impaled on his own spear while in pursuit of a greyhound which was molesting the sheep. The expedition promptly turned back, recrossed the river and headed for the Sonora Valley. All but Díaz made it. He lies buried somewhere along the Devil's Highway.

At this point it would be well to ask, who discovered the state of California? The usual story is that Rodríguez Cabrillo, in 1542, was the first European to see the Golden State. But how about Alarcón? Melchior Díaz?

By now, Coronado and his army had reached Cíbola and were preparing to establish headquarters in the upper Rio Grande Valley. Cíbola had been a great disappointment. Where were the Seven Cities? Possibly there were seven, but they could hardly be compared with the Aztec capital. This was Zuñi country, and the only pueblo of any consequence, at least from the point of view of the Spaniards, was Háwikuh, which Coronado chose to name Granada, "both because it has some similarity to it and in honor of your Lordship" (Mendoza). One wonders what the people back home might have thought of this comparison.

But the natives were most obliging. Once they became aware that the Spaniards were in search of the fabulous, it was easy to send the white conquerors on their way. To the northwest, said the Zuni, was Tusayán, a province with seven cities. "Seven" runs deep in Spanish folklore, but here was an occasion when the number was founded on hard mathematical reality. Following the directions given them by the Indians, some twenty-three soldiers led by Zuñi guides discovered seven towns in Tusayán. This was Hopi country, or land of the Moquis, as the Spaniards were to call it.

It was now mid-July, 1540. Ensign Pedro de Tovar was in command of the Tusayán expedition. A Franciscan friar, Juan de Padilla, "who had been a warrior in his youth," and who at one time had been with Cortés, was brought along to teach the natives the Gospel. The Hopis were in no mood to extend Tovar a welcome. "They had heard that Cíbola had been conquered by very fierce men who rode animals that ate people," writes Castañeda. Hence, in a hostile spirit, the Hopis made it quite clear that the white intruders must remain well beyond the limits of the town. To this the Spaniards objected, and most especially Father Padilla, who apparently still viewed such situations with the eye of a soldier. "Indeed, I do not know what we have come here for," he said. Tovar and his companions accepted this remark as a call to arms, and within a short while the natives were scurrying towards their mesa-top homes. Primitive weapons were no match for what were then modern instruments of warfare — long, well-tempered lances, and gun-

powder and lead, not to mention "animals that ate people."

It may be assumed that some of the natives were killed in the scuffle, though the records are none too clear on the matter. It is well known, however, that the Hopi chiefs did now consent to talk things over on a friendly basis, and as peace offerings the natives gave the Spaniards food and a few turquoises. Tovar was pleased to accept the gifts but demonstrated more interest in what the natives had to say about a deep gorge in the west than in a donation of maize, flour, and piñon nuts. But since Tovar was not authorized to go beyond Tusayán, he and his squad returned to Háwikuh.

General Coronado's imagination was aroused by the story of the deep gorge. Perhaps a great river flowed through it on which sailed the ships of Alarcón. This was something that had to be investigated. So, on August 25, Captain García López de Cárdenas was sent with a command of twenty-five horsemen to find this geographical curiosity. A three-weeks' march carried them through the Painted Desert and the Hopi settlements to the rim of Grand Canyon. Here, near Grand View, they looked out upon one of nature's greatest scenic wonders; but Cárdenas and his men must have been a hard lot, because, so far as we know, not one of them has left us a description of the natural beauty of the canyon. To them "it looked like an arroyo." And where was the great river Coronado hoped they would find? There was certainly a stream off in the distance, "a fathom across." Six feet! The natives quickly corrected this optical illusion by saying that it was "half a league wide." A mile and a half! This the Spaniards would not believe until three of the more agile of the party spent the greater part of one day within the depths of the canyon. We have the names of two of these pioneer Arizona mountain climbers, Captain Melgosa and Juan Galeras, who said they had gone one-third of the distance to the bottom of the canyon where they could see that "the width given by the Indians was correct." The Indians knew their geography; and an unnamed member of Coronado's army said the river was "as large or much larger than the one at Seville." Further details of this, as well as of many other tantalizing but clouded events of the Coronado expedition, may some day come to light, if the lost report of the official chronicler of the army, Pedro de Sotomayor, is found. It is known that he accompanied Cárdenas to the Grand Canyon of the Colorado River.

It was a great disappointment to Cárdenas and his men that they had not reached the river on which they might find Alarcón's ships bulging with supplies; moreover, the party was in desperate need of water. Perhaps there were rivers to the south and west, or at least a spring or a lake. But neither spring nor lake was to be found, not even a water hole. So, after a trek of four days, and after being told by their native guides that there was no water to be found for three or four more days, Cárdenas gave orders to turn back. This was a fortunate decision, for within a few days they had reached a waterfall, near which were some fine crystals of salt. "They . . . gathered quantities of it which they brought and distributed when they returned to Cíbola." Dr. Katharine Bartlett, an authority on early explorations in northern Arizona, places the discovery of the salt deposits near the mouth of the Little Colorado. And salt, like water, is essential to pioneering on any frontier. Thus, although the records are silent in this respect, there is good reason to believe that Coronado's men placed the crystals in their knapsacks; perhaps the crystals would be used to season a steak or lamb chop some evening in front of the campfire along the trail.

Meanwhile, two other contingents of Coronado's army were on the march. Captain Hernando de Alvarado, at the head of a party of about twenty men, was exploring the country to the east of Cíbola, to turn back only after reaching the Canadian River. And from its rendezvous in the Sonora Valley, Captain Arellano's command was pushing north along Coronado's trail.

Leaving a handful of men at San Gerónimo, a name which the Spaniards had attached to their Sonora encampment, Arellano and his troops had begun their march a few days before Díaz went in search of Alarcón. Assuming that they followed Coronado's route, they entered the San Pedro Valley, and thence to Chichilticale. "They found the natives cheerful and submissive everywhere, and without fear," writes the chronicler, Castañeda, who was a member of Arellano's army. And the Indians were generous with their food supply, for, in the vicinity of a place called Vacapán, which Bolton identifies as Arivaipa, they presented the soldiers with quantities of *tuna* preserves. The gift satisfied the hunger pangs of the Spaniards, but it had some serious side effects. For the greater part of twenty-four hours the soldiers were "drowsy with headaches and fever, so that the Indians could have done great harm to them

if they had wished," says Castañeda. This was further proof of the "submissive" nature of the Indians.

The "army Señora," as the soldiers chose to call it, recovered from its bad case of indigestion and moved on to other adventures along the trail. A day's march beyond Chichilticale the army was interrupted by a flock of mountain sheep which aroused the hunting instincts in some of the advanced guard. The soldiers gave chase, but, writes Castañeda, who accompanied the hunters, the sheep "are fleet in rough country, so we could not overtake them and had to let them go." The chase was perhaps in the neighborhood of Eagle Pass, and Castañeda left the first written record of these Arizona animals.

Three days later, Arellano's army "learned another bit of natural history" when it reached what apparently was the Gila River. Here they stopped to examine a horn, "a fathom long and as thick at the base as a man's thigh. By its shape it looked more like the horn of a buck than of any other animal. It was worth seeing." Indeed it was, not only because of its astounding size, but also because Coronado had placed it on the trail to mark the route to Cíbola.

The travelers now pushed on into the high country where, within a day's journey from Cíbola, "there arose in the afternoon a bitter cold whirlwind, followed by a heavy snowfall, which brought considerable hardship to the Indian servants." They came from the warm climes of the south, and there was now "plenty to do taking care of them and carrying them on horseback while the soldiers walked." Thus, pioneering did strange things to ethnic relationships; but the frontier was no place for race snobbishness, especially in situations where an Indian guide and interpreter spelled the difference between success and failure of an enterprise.

Arellano's contingent pushed on to Cíbola without other incidents of note. Here they were joined by the discoverers of Grand Canyon and by some of the men who had gone east with Alvarado to the Canadian River. In his march across the Rio Grande Alvarado had reached the heart of the Pueblo country, a region which he strongly recommended as an excellent site for winter quarters for Coronado's army. The recommendation was promptly seized upon. Coronado thus established his headquarters in the province of Tiguex, and in the following spring went in quest of fabulous Quivira, only to return to the Rio Grande for another winter and disappoint-

ment; and in April, 1542, Coronado was forced to abandon his enterprise and lead his men back down the trail to Nueva Galicia and to the misfortunes of a courageous but, in the eyes of jealous contemporaries, an unsuccessful and incompetent discoverer. All of this, of course, is significant history but falls outside the scope of the present narrative.

Forty years were to pass before interest was renewed in this far frontier of New Spain, as all of present-day Mexico was called during the colonial period. The coastal plains of the Gulf of California had served and would continue to serve, after the opening of the seventeenth century, as a corridor to Arizona. A second corridor, the great Central Plateau of Mexico, became an avenue to New Mexico and northern Arizona, and by 1570 soldiers, miners, and missionaries had reached a point on the Conchos River, a little more than eight hundred miles down the plateau from Mexico City. Here, in the Conchos Valley, two settlements were founded, Santa Bárbara and San Bartolomé, both of which were to become bases for the Spanish advance into New Mexico during the closing years of the sixteenth century. And the authorities had anticipated the importance of this distant frontier when, in 1562, they had created the province of Nueva Vizcaya, comprising a region in the northwest beyond a line of some indefiniteness stretching from about Saltillo, Coahuila, to the southern limits of the present state of Sinaloa.

An advance of well over 600 miles north of this line was occasioned in the opening years of the 1580's by reports at Santa Bárbara and San Bartolomé of northern Indians who had a culture worth exploiting; moreover, so the story went, there were large settlements of people in the area with little or no knowledge of Christianity. If the reports were true, why not send missionary, soldier, and miner to take possession of the country for the King of Spain? And how about the rumors of English activities in the north? For after all, Francis Drake had only recently sailed the coast of California and had taken possession for his monarch. Perhaps he had discovered the elusive Strait of Anián. If he had, then the English were in a favorable position to sail from the Atlantic to the Pacific, or the South Sea as it was often called, and thence to the riches of the Orient. International rivalry for this part of the continent was in the making.

Thus, on June 5, 1581, a party of about twenty-eight persons, comprised of three Franciscans, nine



The Spanish Past. Five panels from Jay Datus' mural illustrate the period of exploration and conquest. Courtesy Southern Arizona Bank and Trust Company, Tucson

soldiers, and some sixteen Indian servants, left Santa Bárbara for the land of the Pueblos. Traveling by way of the Conchos and the Rio Grande, they reached a point not far from present Bernalillo and visited Acoma and Zuñi. Chamuscado, in command of the soldiers, became disappointed in his search for gold and silver and ordered his men to return to Santa Bárbara. Two of the missionaries, Agustín Rodríguez and Francisco López, chose to remain with the Pueblos, even though the third friar, Juan de Santa María, had been killed by the Indians. None of this expedition, either missionary or soldier, had stepped within the present limits of Arizona; but there is evidence that somewhere in the vicinity of Zuñi they had heard of the Hopi villages, "where there were five large pueblos with many people. According to the signs which the Indians made," writes a member of the party, "they understood that two of the pueblos were very large, and that in all of them large quantities of cotton were raised, more than any other place which they had seen."

The Franciscans at Santa Bárbara feared for the lives of Rodríguez and López. A rescue party was therefore promptly organized, and a wealthy Mexican, Antonio de Espejo, offered to finance the

expedition and to accompany it in its search for the friars. The offer was accepted, and on November 10, 1582, the party set out from San Bartolomé, following the route which had been opened up by Chamuscado and the Franciscans in 1581.

This enterprise is known to history as the Espejo expedition, which was comprised of some fifteen soldiers, together with Fray Bernaldino Beltrán and some Indian servants and interpreters, and over a hundred horses and mules. Reaching the New Mexico country, they learned that both Rodríguez and López had been killed by the Indians. Thus, Beltrán believed that he had accomplished his mission and was therefore anxious to return to the Conchos settlements. But Espejo and his soldiers had come to see the sites and to look for mines. One expedition for this purpose reached the northern part of Arizona.

By the middle of March, 1583, the party had reached the Zuñi pueblos, where the Indians told Espejo about Coronado's visit to the region and said that there were mines west of Háwikuh and that not very far away was the province of Mohose, another name for the Moqui, or Hopi, country. These were tales which drew Espejo and nine adventurous soldiers on west, together with some friendly Zuñi Indians. The rest of the party, including Beltrán, remained behind. The route they followed was no doubt over a well-trod Indian trail to the Hopi villages: generally west to the Puerco River, which they crossed at a point about twenty miles east of the present town of Holbrook, thence northwest and north across Leroux, Cottonwood, and Jedito washes. Perhaps they were following the same trail that Tovar and Cárdenas had used some forty years earlier.

On April 17, after a march of ten days, Espejo's party was greeted near Jedito Wash by "a few of the bravest" Hopis from Awátobi, or Aguato as the natives called it. The Indians protested their interest in peace; and by "sunset so many people came from Aguato in a short time with tortillas, tamales, roasted ears of green corn, maize, and other things, that although our friends (the Zuñi) were many, they had half of it left over," writes Diego Pérez de Luxán, who was one of the nine Spaniards who accompanied Espejo on this *entrada* into Arizona. And a great feast it must have been, for Espejo tells us that he had one hundred and fifty Zuñi Indians in his entourage, not to mention "three Christian Indians" who had been in Coronado's army and had

chosen to remain in Cíbola.

After the banquet, and after Espejo had given the Hopis "some presents of little value" as tokens of friendship, the Spanish captain asked the Hopis to build a corral for the horses. "We . . . told them that the horses we had with us might kill them because they were very bad, and that they should make a stockade where we could keep the animals, which they did." So states Espejo. Luxán says, "We asked them to build a fortress of dry masonry in which we could keep the horses, because the friendly Indians told us that we could not trust them." But a close examination of the documents leads one to the conclusion that neither man was telling the whole truth. The region was teeming with Indians — so it seemed to Espejo and Luxán. How could ten soldiers hope to cope with the fifty thousand Indians Espejo said he saw, especially if they took to the warpath? Luxán was a bit more conservative in his estimate of the number of Indians in Hopi land: "The Lord willed . . . that the whole land should tremble for ten lone Spaniards, for there were twelve thousand Indians in the province with bows and arrows, and many Chichimecos whom they call Corechos." Thus it would be worth a guess to say that the "fortress" was designed quite as much for defense as for corralling the horses.

Espejo and his little army now marched on to Aguato (Awátobi), Gaspe (Walpi), Comupai (Shongopovi), Majanani (Mishongnovi), and Olalla (Oraibi). Six days were spent visiting the villages, and possession of each "was taken for his majesty in the main plaza with a salvo of arquebus shots." The natives everywhere were generally friendly and exceedingly generous. On one occasion the chiefs gave the soldiers "four thousand cotton *mantas*, some colored and some white." The Spaniards were pleased with the gift, but some of them were more interested in what the Hopis had to say about mines than in praising the natives for their mastery of the art of weaving. Perhaps these were the mines from which the Zuñi people said ore had been taken and given to Coronado.

The mines, so the Hopis said, were to be found far to the west, where the country was arid and difficult to traverse. Moreover, it was a region of "many barbarous people who could kill us by throwing mere handfuls of dirt," says Luxán. Espejo therefore believed it would be wise to divide his party into two equal parts, one to go in search of the mines, the other to return with the baggage to Cíbola. The five



who chose to prospect for mines might lose their lives, but there was good reason to believe that the remaining five would succeed in reaching Cíbola.

On April 30, both contingents began their march from Aguato, and both were destined to complete their missions without loss of life. Espejo, leading what no doubt was the first band of white prospectors in Arizona, headed southwest. A march of five leagues carried them to a waterhole. "We named this place El Ojo Triste," writes Luxán. This was an appropriate name — Sad Waterhole — for the reason that it was virtually dry and "was insufficient for the horses, so they were two days without water." On the following day, May 1, they continued their march and spent the night on the banks of the Little Colorado, "a fine, beautiful river . . . containing many groves and willows." According to Dr. George P. Hammond, the recognized authority on the Espejo expedition, the party had reached a point not far from the mouth of Cañon Diablo.

Continuing southwest, through a country "of many large pools of rainwater . . . rich in . . . pastures and cedar forests . . . and ash trees," and after a two-day march, they set up camp at a spot some ten or fifteen miles south of the present city of Flagstaff. Here, for the first time since leaving the Hopis, they were molested by Indians, who were attracted to the camp by their curiosity to see the strange animals which the Spaniards were riding. But, says

Luxán, the Indians "fled when they heard them as they found the sound unfamiliar." (The horses must have neighed.) So these "warlike mountainous people," as the soldiers described them, chose to remain at a respectable distance along the entire route. This was a fortunate development, at least for the Spaniards, for within a day or two Espejo was to move into the country of the Yavapai, a people whom the white man at a later time had great difficulty in conquering.

The last stage of the journey, of some forty or fifty miles, was over rough, forbidding country to Sycamore Creek, which the soldiers named Río de las Parras, or River of the Vines, since "this river is surrounded by an abundance of grape-vines." Espejo approached the creek by descending a steep rise, "so steep and dangerous that a mule belonging to Captain Antonio de Espejo fell down and was dashed to pieces." That night and the next day, May 6, they spent near the Sycamore. On the following morning they broke camp and pressed on some six leagues, marching "at times close to the Parras river." Here they found an abandoned native village, though not far away they saw some Indians "seated around with their heads low, singing of the peace they wished with us." This was good news, as was the discovery of mines on the following day. At least the discovery of the mines was good news to Espejo, who says, "I found them, and with my

own hands I extracted ore from them, said by those who know to be very rich and to contain much silver." But Luxán disagreed with his chief: "We did not find in any of them a trace of silver, as they were copper mines, and poor." But both are in general agreement on matters relating to the natives and the geography of the country. The discovery was close to the Verde River, which the Spaniards named the Río de los Reyes (Kings River), on whose banks were "Castilian grapes, walnuts, flax, blackberries, maguey plants, and prickly pears." The Indians raised maize, lived in good houses, and were very friendly; and by signs they told Espejo that beyond the mountains was a very large river, "eight leagues in width and (which) flowed towards the North Sea." They were no doubt referring to the Colorado, but they had it flowing in the wrong direction, if we are to believe Espejo's narrative. Or the Spaniards may have misunderstood what the natives said, for the correct reference should have been to the South Sea, as the Pacific was called during a great part of the colonial period.

Having reached their objective, Espejo and his men did not tarry on the banks of the Verde. On the eighth they gathered together their effects and began their return journey to Zuñi over a course somewhat different from the one they had taken to the mines. Unfortunately, the records are silent on the route which they were now to follow, aside from the laconic remark of Espejo that, "We endeavored to return by a different route so as to better observe and understand the nature of the country, and I found a more level road than the one I had followed in going to the mines." They made their way to the vicinity of Awátobi, and thence to Zuñi, where they arrived on May 17. Thus, within a week after leaving the Verde they were back in Zuñi, a distance of well over 300 miles, which is something of a record for horseback riding through a region of steep mountains, deep ravines, and thick forests, a challenge to the best of equestrians.

The Espejo expedition, after a few months of exploration in New Mexico, made its way back to San Bartolomé, arriving there on September 20, 1583. The report that Beltrán and Espejo made about the deaths of Rodríguez and López was sad news; and the tales the missionary and the captain had to relate about a land of numerous Indians and rich mines, not far from which the natives said there was a lake of gold, created an atmosphere of expectant activity along the northern frontier and

at points as far south as Puebla. Espejo himself had visions of returning to New Mexico, though for reasons none too clear he was not again to be sent north. In Puebla one enthusiast for exploration asked for authority to lead an expedition to search for a northern strait that, so he said, connected the South Sea with the North Sea and lay well beyond the upper limits of New Mexico. Others, not waiting for official approval, made *entradas* across the Rio Grande, one of which turned northeast and went as far as the Platte River. But it was not until the closing years of the sixteenth century that another official expedition was sent to New Mexico.

The leader of this party was none other than Juan de Oñate, the wealthy son of a still more wealthy father, who was one of the discoverers of the bonanza silver mines at Zacatecas. By marriage, Oñate the younger was also one of Mexico's "400" of the day. His wife was the granddaughter of Cortés and great-granddaughter of Montezuma. Thus, wealth and family position, plus a strong desire to make a name for himself, enabled Oñate to obtain a contract for the conquest and settlement of New Mexico. In return for bearing the expenses of the expedition, he was granted extensive privileges as governor and captain-general of the enterprise; but jealous rivals and a change in viceroys delayed his departure for nearly two years.

Finally, on February 7, 1598, under orders to conquer and to colonize New Mexico with a party of missionaries, four hundred men, and several families, Oñate started his northward march from the Conchos River Valley. With some minor variations, Oñate followed the route opened by his Spanish predecessors to New Mexico, and not far from the present site of El Paso he took formal possession of the region in the name of the Spanish crown. Pushing on up the valley, he reached the pueblo of Caypa, which he made his headquarters and from which he was to send soldiers to explore the country and to conquer the Indians. Oñate's subsequent subjugation of the Pueblos in New Mexico is one of the Southwest's great epics.

Espejo's mines, together with Indian accounts of pearls, which convinced Oñate that the South Sea must be nearby, attracted the governor and some of his men to the west. And not the least of these attractive forces was the possibility of finding the South Sea, for New Mexico could then "trade with Peru, New Spain, and China," says Oñate. So, on October 6, 1598, Oñate and some of his men, including Cap-



tain Marcos Farfán, who was second in command, began their westward march. Their route no doubt was over a well-beaten path from the Rio Grande to Zuñi. Here they spent several days, during which time Farfán made a short *entrada* into Arizona in search of a salt spring which the natives said was nine leagues away. The Indians knew what they were talking about, for Farfán says he found the "best saline in the world . . . a league around . . . and . . . a depth of over a spear's length." This saline was certainly not the one that Coronado's men had discovered somewhere near the mouth of the Little Colorado, since it only took Farfán three days to make the round trip to the spring. Yet, no one has been able to identify the site of the discovery.

On November 8, Oñate's entire party set out for the Hopi villages, probably over the same trail that Espejo had followed. It was mid-winter, the snow was falling, and the soldiers and animals suffered from the lack of sufficient water. They seem, however, not to have been molested by the Indians, and reached the Hopi villages after a three day's march. Here — perhaps at Awátobi — Oñate decided to send eight men under the command of Farfán to find the mines, while the governor himself and the rest of the party would return to the Zuñi province and there await the return of Farfán. Neither Farfán nor Oñate tell us why this decision was made. Perhaps the governor did not wish to submit his entire

group to the dangers of a severe winter and hostile Indians.

On November 17, Farfán and his companions started down the trail for the "rich mines." Perhaps they followed the one used by Espejo. Authorities are not in agreement, either as to the route, or as to the sites of the mines which Farfán discovered. Bolton traces the route somewhat parallel to that of Hammond's description of Espejo's trail, though Bolton is not in agreement with Hammond on the site of the mines. According to Bolton, the mines were on Bill Williams Fork, not near the Verde. Bartlett contends that there were two possible routes which Farfán could have followed, though she has a preference for Espejo's line of march. Both Hammond and Bartlett believe the mines were in the Verde Valley, and the latter scholar is willing to commit herself to the precise spot: "undoubtedly . . . the present location of the United Verde Copper Company at Clarkdale."

Whatever the route may have been, Farfán has given us the first classic description of the region as to its geography, ethnology, flora, and fauna. The details, of course, cannot be included within the limits of this paper. Suffice it to say that he found the Indians peaceful and numerous and the land abounding in game and in tall pines and fertile valleys. There were times when the going was difficult, but Farfán does not dwell on this. The import-

ant thing was the objective, which he reached on November 23.

On the following morning, six Indians led Farfán to a mine, "which was at a good height . . . There they found an old shaft, three *estados* in depth [16 ft. +], from which the Indians extracted the ores for their personal adornment and for the coloring of their blankets, because in this mine there are brown, black, watercolored, blue, and green ores." Nearby was a large dump, and Farfán noted that there was a wide vein of rich ore which "crossed over to another hill." And at still another point they found a vein "two arms' length in width" which they named San Francisco. "The veins are so long and wide," says Farfán, "that half of the people of New Spain can have mines there." Bonanza! The soldiers promptly staked out some thirty claims, for themselves and their companions at Zuñi.

The discovery of the ores did not engage the entire attention of Farfán. After all, so the story went, the South Sea was not far away; and the captain's native informants at the mines corroborated the story by saying that there was a great river in the west, on whose banks lived "immense settlements of people" and which emptied into a sea. Good news, indeed; but Farfán was not commissioned to go in search of the sea. It was his duty to make a prompt report of his discovery of the mines. Thus, by what appear to be forced marches, the expedition retraced its route to Zuñi, carrying with it samples of ore. Fatigue, however, compelled seven members of the party to spend a few days in the Hopi country while Oñate and one soldier hurried down the trail to Zuñi, which they reached by December 11.

The governor was pleased with the results of Farfán's discovery, but conditions in the Rio Grande Valley were of more immediate importance than organizing an expedition for further ventures in the west. That could wait; and it did. It was not until 1604 that Oñate was able to return to Arizona, though there is some evidence that one of his men, Vincente de Zaldívar, in 1599, led a party of twenty-five men westward, to "a point which he was told was three days from the sea." If this is true, he must have been in, or passed through a part of, Arizona.

Oñate's journey to the Gulf of California is one of the most notable chapters in the history of Arizona explorations. On October 7, 1604, Oñate set out for his capital in New Mexico, with an army of thirty men, "most of them raw recruits," says one of Oñate's fellow countrymen, who, about twenty

years later, was to write one of the best accounts of the journey. Attached to the army were two Franciscans, Juan de Buenaventura and Francisco de Escobar. The latter left a diary of the enterprise.

Despite our sources, which are none too plentiful for the expedition, it is most difficult to trace with accuracy the route followed to the Colorado. Bolton and Bartlett quite naturally agree on the route to the Hopi villages, but are in disagreement on the course taken from there to Bill Williams River. Bolton seems to place this segment of the route somewhat west and north of Bartlett's, though both of them agree that the party reached the forks of the Bill Williams, thence down the river to the Colorado, which Oñate called Buena Esperanza, or Good Hope. From this point it is not difficult to trace Oñate's route. He turned up the Colorado to, perhaps, a point near Needles, then faced about and traveled down the east bank of the river to the mouth of the Gila, to which they gave the name of Nombre de Jesús, or Name of Jesus. Leaving some twenty horses here to graze, "so that they might be in condition to make the return trip to the provinces of New Mexico," Oñate and his men proceeded down the river to the Gulf, where, on January 25, 1605, "We took . . . possession . . . for the glory and honor of God our Lord." The Spaniards knew their geography well enough to know that they had not reached the South Sea but the Gulf of California. And how about the pearls that were supposed to be found? The natives were familiar with these lustrous gems, "but," writes Escobar, "we could not find a single one among the Indians, even though the governor did his best."

Oñate may have been disappointed in not having found the South Sea and a land of pearls, but he and his companions heard many an exciting story from the natives living on the banks of the Colorado. Mohave Indians from the vicinity of Needles spoke of the great Lake of Copalla where the natives wore bracelets of gold and from whose shores migrated the people who settled in Mexico. The Spaniards took this to mean the Aztecs. The story was repeated and elaborated on as the Spaniards traveled down the river. There was also an island of gold and silver, said the Indians; and as proof that there was silver to be found, the Indians pointed to the silver plates which the Spaniards carried and said that they were of the same metal which the Indians west of the Colorado used for cooking utensils. Some of the soldiers may have believed this tale, but Father



Escobar had his doubts: "Only an examination of the metal, in case it exists, as so many Indians affirm, will dispel my doubts." Then there was the account of an island ruled by a chieftainess, "very corpulent, very broad, and with big feet." Here, too, was silver, and most of the men of the island were bald. And, so the stories went, there was a nation of people whose ears were so long that five or six persons could stand under each ear, and not far away were natives who slept under water, not to mention a tribe whose people had only one foot, and still another which slept in trees. Moreover, the Indians wanted the Spaniards to know that there were people in the region who lived solely on the odor of their food, and others who slept standing up. Escobar entered all of this in his diary, not because he was willing to believe "such monstrous things," but merely as a matter of record. "Each one may believe what he wishes," he writes. Perhaps the soldiers were a bit more credulous than the friar.

Oñate now felt that it was time to return to the Rio Grande; and after five or six days of exploring near the mouth of the river, the expedition started its return journey. At the junction of the Gila and the Colorado the soldiers stopped to round up the horses they had left behind on their way down the river, only to learn that the Indians had eaten about half of the animals. This was a serious loss, but the Spaniards were wise enough to know that they should

not punish the natives. So far, the Indians everywhere had been quite friendly. A battle with the Indians here would only cause trouble further up the trail. After all, according to the records, there were twenty thousand Indians living just along the east bank of the Colorado between its mouth and the Gila! This no doubt then was a prudent decision, for the tribes remained peaceful all along the route, which, apparently, was the one the expedition had taken on its outward journey. They reached their New Mexico capital, San Gabriel, on April 25, 1605, "all sound and well, and not a man missing," writes one of the early Spanish chroniclers of New Mexico.

Thus ended the first great period of exploration in Arizona (1540-1605). The next seventy-five years, despite the fabulous stories and the evidence of rich mines, Spanish activity in the region was mainly confined to missionary enterprises in the northwestern parts of the present state, enterprises, however, which were short-lived and seldom successful. And the center of Spanish interest in the area continued to be in the Hopi country. The Navajo, to the north and east of the Hopi, were relatively insignificant at the time of discovery, and it was not until the opening years of the eighteenth century that the Spaniards made any concerted attempt to conquer and Christianize these natives.

The religious conquest of the Hopis began in 1629 when three Franciscans, Francisco de Porras,

Andrés Gutiérrez, and Cristóbal de la Concepción—all from New Mexico—were commissioned to found missions among the Moqui. In the spring and summer of that year, “with their crucifixes at the neck and staffs in their hands” and accompanied by twelve soldiers, the three missionaries made their way from the Rio Grande and Zuñi to the Hopi villages. They reached Awátobi on August 20, St. Bernard’s day, and in honor of the occasion they gave the saint’s name to the village. “Here,” writes a contemporary, “the friars were received with some coolness, because the devil was trying in all possible ways to impede and obstruct the promulgation of the divine law.” According to the record, the devil was obtaining considerable help from an apostate Indian who had entered the village shortly before the arrival of the missionaries and the soldiers. The Spaniards, so he said, were coming to burn the villages, “steal their property, and behead their children.” Moreover, he warned the Indians not to be deceived by the men in the party who wore trousers and vestments, for they were imposters and would sprinkle water on their heads, a ceremony which would certainly kill the recipients. Thus, the missionaries and soldiers walked into an atmosphere of hostility, and for two nights the Spanish guards were on the alert for an Indian attack.

The Indians chose not to attack the Spaniards, but the spirit of hostility lingered on, even though the missionaries tried to win the friendship of the natives by distributing trinkets such as knives, beads, rattles, and hatchets, “in order to make them feel that the friars came to give rather than to ask of them.” But then there was to be a sudden change in the attitude of the Hopis, a change for the better which the Franciscans said was brought about through a great miracle, or the healing of a blind Hopi boy by Father Porras. Shortly thereafter, so say the priests, this resulted “in the conversion of a thousand Indians.” This was a turn of events which angered the Hopi shamen, who now awaited the opportunity to rid the country of the white man’s priests. Nearly four years passed, however, before the opportunity presented itself, when, on June 28, 1633, Porras died from eating food which had been poisoned by the Indians. The Franciscans thereupon withdrew from the Hopi villages, though there is some evidence that, during the years 1641–72, the friars did return for short periods of time. Then, shortly before the Pueblo Revolt of 1680, the Franciscans again undertook to Christianize the Hopis,

only to meet their deaths during the revolt. Though we know very little about the careers of these martyrs, we do have their names: Fray José de Figueras, who was killed at Awátobi; Fray José de Trujillo at Shongopovi; and friars José de Espeleta and Agustín de Santa María at Oraibi. It is at this time, too, and no doubt owing to fear of Spanish vengeance, that the Hopis removed their towns from the foot of the mesas to more defensible positions on the summits, where their villages may still be seen. But the Spanish soldiers were not sent out immediately to punish the natives, for the reason that the Spaniards themselves had been defeated by the Pueblos and were compelled to retreat to El Paso. Here they remained for more than a decade before they were able to reconquer the New Mexican Indians.

The successful reconquest of New Mexico was accomplished under the leadership of Diego de Vargas, one of Spain’s ablest frontier governors. In the fall and winter of 1692 Vargas and his army made its first effective march into the upper Rio Grande Valley and to the Hopi settlements. Here, at the Hopi villages, which the governor reached on November 18 with an army of sixty-three picked soldiers and two missionaries, the natives at first showed signs of hostilities. But the well-armed soldiers, together with Vargas’ apparent intentions to treat the Indians in a friendly manner, caused the natives, with the exception of those at Oraibi, to agree to live in peace with the Spaniards. Vargas then planned to use force, if necessary, to bring the Oraibi people to terms, a plan, however, that did not meet the approval of the governor’s lieutenants. The weather was severe, the horses and mules were all but exhausted, and there was not a single water hole on the route they would have to follow to the village. The lieutenants therefore argued that the loss of their horses would be a disaster for the army. Vargas heeded the advice of his lieutenants, and on November 24 the army began its return march to the Rio Grande by way of Zuñi.

But Vargas had learned something else about the country. To the west of the villages, so he had been told, were rich silver and quicksilver mines in the Sierra Azul and Cerro Colorado, two more of the many fabulous sites in early Arizona history. In the Sierra Azul, said one of the Indians, was an “ochre deposit . . . in a large round pool, in the form of a reddish liquid which sometimes moved and changed in color.” The story was not new to Vargas, for he had heard of the Sierra Azul even before he



had left El Paso, and he now hoped that his journey to the Hopis would enable him to verify the story. And, as was so common in the history of the conquest of the northern borderlands of New Spain, Indians were very anxious to spin yarns about silver and gold mines, especially when they discovered that this was one sure way to encourage the Spaniards to move on. Vargas, however, was not prepared to go in search of the Sierra Azul, though he did obtain some samples of ore which the natives said came from the mines. A few months later, the ore was assayed and found to be very low grade. Nevertheless, the Sierra Azul myth continued to stir the imaginations of the Spaniards for many years.

The Hopis, with the exception of those at Oraibi, may have promised Vargas that they would remain friendly, but Vargas and his army were soon to discover that none of the Indians in the region intended to keep their promises. Throughout the rest of the colonial period the Hopis remained recalcitrant, and often allied themselves with the Najavos, the Utes, and the Pueblos in their attacks upon the Spaniards. During the Pueblo revolt of 1680 and the lesser uprisings of 1696, many of the natives of the Rio Grande fled to the Hopi country and were not to return to their homes in the east. A few, however, in 1748, were forced to abandon their town of Payúpki, on the Middle Mesa, and to settle at Sandía. And in the eighteenth century several

notable punitive expeditions were sent against the Hopi, one of the most significant under the command of Governor Phelix Martínez in 1716. He spent twenty days in the Moqui province with an army of sixty-eight soldiers, a dozen or more members of the Santa Fé cabildo, and 255 "loyal Indian auxiliaries." But this show of force did not frighten the natives to the point of making peace with the governor. They chose to fight, a decision which cost them the loss of several lives and many head of livestock, as well as the destruction of a great part of their maize fields. Nevertheless, they were not to be conquered, and Martínez was compelled to retreat to the Rio Grande. And it was during this period, too, (1680–1750) that the Apache menace grew to serious proportions, all the way from the upper Rio Grande and northern Arizona to the Spanish settlements in Sonora and Sinaloa.

Thus, the sixteenth and seventeenth centuries had been a period of spying out the land, searching for the fabulous, and attempting to subjugate the Indians in northeastern Arizona. This was a story which was to continue throughout the eighteenth century, though the scene was to change and a few new elements were to be introduced into the historical development of Arizona. The main lines of Spanish approach were no longer to be from the Rio Grande but from Sinaloa and Sonora. Of course the Indian frontier was to pose its problems, yet mis-

sionary, soldier, miner, and farmer came to stay.

The northwest frontier of New Spain had come to rest for half a century, from 1540 to 1591, in the vicinity of Culiacán. But in the latter year, with the coming of the Jesuits to the Sinaloa Valley, foundations were laid for a hundred-year march, valley by valley, to the present boundaries of Arizona. The Jesuits carried the Cross and founded the missions until 1767, when they were expelled from all the Spanish dominions; but theirs was not labor lost, for the Franciscans were promptly sent to replace Loyola's sons. Both, Jesuit and Franciscan, like their brethren in northern Arizona, were to win the martyr's crown. And both marched side by side with the soldier, who at times found it most difficult to view frontier conditions in the same manner as his missionary companions. Then there was the miner, Indian and Spaniard, who often found himself at cross-purposes with missionary and soldier. Thus, from all of this, arose difficult administrative problems for the authorities in Guadalajara, Mexico City, and far-away Spain.

In an effort to meet these problems, new jurisdictional areas proceeded along with the advance of the frontier, such as Sinaloa, Ostimuri, Sonora, Pimería Baja, Pimería Alta; and in the closing years of the eighteenth century, as one desperate effort to integrate the administration of the entire northern borderlands of New Spain, the famous Interior Provinces was created and placed under the direction of a commandant general, whose headquarters were to be at Chihuahua City. This vast region, as was the case in nearly every administrative reform for the borderlands, was established only after careful planning for improving the military defense of the region against both Indians and hostile European powers. The Spanish authorities were therefore careful to select their most competent subjects to make the necessary investigations and recommendations for frontier reforms. Hence it was that Pedro de Rivera, in the years 1724 to 1728, made a tour of inspection of the military outposts across the entire frontier and recommended some important reforms. In 1766, the Marqués de Rubí was sent all the way from Spain to inspect the military posts, especially with a view towards checking the depredations of the Apaches. In 1769, one of the king's most important ministers, José de Gálvez, visited Sonora and, on the basis of his and Rubí's reports, brought about the creation of the Interior Provinces. Six years later, Inspector Commandant Hugo O'Connor set about,

with some success, in putting into effect the several recommendations for reorganizing the northern military frontier.

The two most significant institutions, then, were the presidio, or military garrison, and the mission. The presidio — usually a walled fort — was located at strategic points near potable water and sufficient pasturage for horses. The command of the post was commonly in the hands of a captain, commissioned either by the local governor or by officialdom in Mexico City. The second in command was either a standard bearer or a lieutenant, and the normal complement of the garrison varied from twenty to fifty men, some of whom were assigned to the nearby missions. Here it was their duty to protect the resident missionaries and to accompany them on their visitation to outlying Indian villages. There seems to have been no specific term of enlistment, if "enlistment" is the proper word, and the soldier's paymaster and supply officer was the captain of the presidio. The records are therefore replete with instances of graft at the expense of many a soldier. Yet, despite the hardships faced by these frontier soldiers, there are few if any accounts of mutiny but many instances of the presidial's excellent fighting qualities. Occasionally, one might desert, a practice which is hardly unique in the history of armies. Occasionally, too, in times of emergencies, the presidials were assisted by town militia.

The mission system came to the New World shortly after the Columbian discovery and followed the course of the Spanish empire everywhere in the Americas. As noted above, the missions on the northern frontiers of New Spain were assigned to the Jesuits and the Franciscans. Of course, the first duty of the missionary was to propagate his faith, but he was never to overlook the fact that he was also one of the king's principal economic and political agents. It was the missionary who brought European crops to the frontier, taught the Indians the most advanced methods of agriculture and animal husbandry, and supplied nearby presidios with the products of the fields and mission shops. It was the missionary also who often served as the frontier diplomat and ambassador. By the processes of acculturation, mission Indians were brought within the sphere of the Spanish political system, and the archives are full of missionary reports on ways and means for dealing with rival European powers.

The first of these missionary diplomats in southern Arizona was the famous Jesuit, Eusebio Fran-

cisco Kino. Born in Italy and educated for the priesthood in Germany, he was to be sent to Baja California and northern Sonora. His assignment to Baja California was short-lived, owing to the fact that the authorities on the mainland were unable to provide adequate supplies for the peninsula enterprise. Kino and his companions were therefore recalled, and the Jesuit, upon the advice of a friend, accepted an appointment, in 1687, as missionary to the Pimas, who lived on the northern borders of Sonora. In March, he chose an Indian village on the upper San Miguel as the site of his mission, which he named Nuestra Señora de los Dolores. From this point and until his death in 1711 Kino was to make no less than thirty major expeditions, which took him at various times to the native settlements on the Altar, the San Pedro, the Santa Cruz, the Gila, and the Colorado. Nor did he neglect to make a trip or two to the Gulf coast in search of geographical knowledge. This was Pima Land, or Pimería Alta, extending north and south from the San Ignacio River to the Gila, and east and west from the San Pedro to the Gulf. It was a region which was administered as a part of the province of Sonora, and the province itself was included within the kingdom of Nueva Vizcaya.

It has been said that during Kino's day Pimería Alta had a population of some 30,000 Indians. The most numerous group, the Pima tribe, lived in villages near the head waters of the Sonora, the San Ignacio, the Altar, the San Pedro and the Santa Cruz. There were also a few who resided in the region between Gila Bend and the Casa Grande. The Sobaipuris lived on the San Pedro and had their principal village at Quíburi, whose ruins may still be seen a short distance north of present day Fairbank. These, too, were of Piman stock, differing mainly from the Pimas to the west in their warlike characteristics. (The Sobaipuris had to be warriors, for they faced the Apaches to the east.) Another Pima-speaking group, the Sobas, were found along the lower San Ignacio and Altar rivers, and their principal town was at Caborca. Astride the present international boundary and generally west of the Santa Cruz Valley was still another Piman people, the Papagos, whose struggle for existence in their arid environment brought about culture traits which differed from their linguistic brothers on the rivers. Scattered in villages along the Gila, from about the bend to near the river's mouth, were the Cocomaricopas. At the junction of the Colorado and the Gila lived

the Yuman peoples, south of whom, and extending to the delta, were the Quíquimas. (The Colorado River people, especially south of the Gila, present an interesting problem in ethnography, both as to names and numbers. Even a cursory comparison of the Oñate documents with those of Kino and his contemporaries proves the point.)

These, then, were the Indians whom Kino and his companions taught the European way of life; and native leaders often became the Jesuit's acculturation instruments. At Dolores was powerful Coxi, chief of many of the western Pima villages. It was Coxi, christened Don Carlos by Kino, who persuaded his people that the Spaniards were the Indians' friends and would bring them happiness. The natives responded by building Kino's church, which was dedicated on April 26, 1693. At Quíburi was Chief Coro, who remained a pagan but was always faithful to Kino, and who served both Spaniard and Indian alike by sending his Sobaipuri warriors against the Apaches. Down the Altar Valley, a short distance south of Caborca, was El Soba, warlike leader of the natives in the valley but willing to assist Kino on the missionary's treks to the Gulf.

But native chiefs alone, despite their friendship for Kino, could not maintain "peaceful coexistence," especially in the Altar, where, in 1695, the Indians rose in rebellion and killed Father Francisco Xavier Saeta, a young Sicilian priest who had only recently been sent to establish a mission at Caborca. Though for nearly a year there had been unrest in the outlying villages, or *rancherías*, before the Pimas went on the warpath, neither Kino nor his missionary companions were apprehensive about Indian loyalties in southwestern Pimería. For reasons none too clear, the rebellion began at Tubutama, north of Caborca, and on April 2 a band of natives, in the guise of peace, entered Saeta's quarters and "filled his poor body with arrows till he resembled Saint Sebastian," writes Bolton. The rebels then turned on some of the father's servants, whom they also slayed, and then marched up and down the valley, in the wake of plunder, fire, and death.

To Kino and his associates this was a most unhappy turn of events. The leaders of the uprising must certainly not go unpunished, but would it be wise to use sword and gun to reestablish peace? Violence might only lead to further violence. It would be enough to bring only the leaders to trial and justice, not the rebels in general. But this was a plan which went awry when fifty Indians appeared

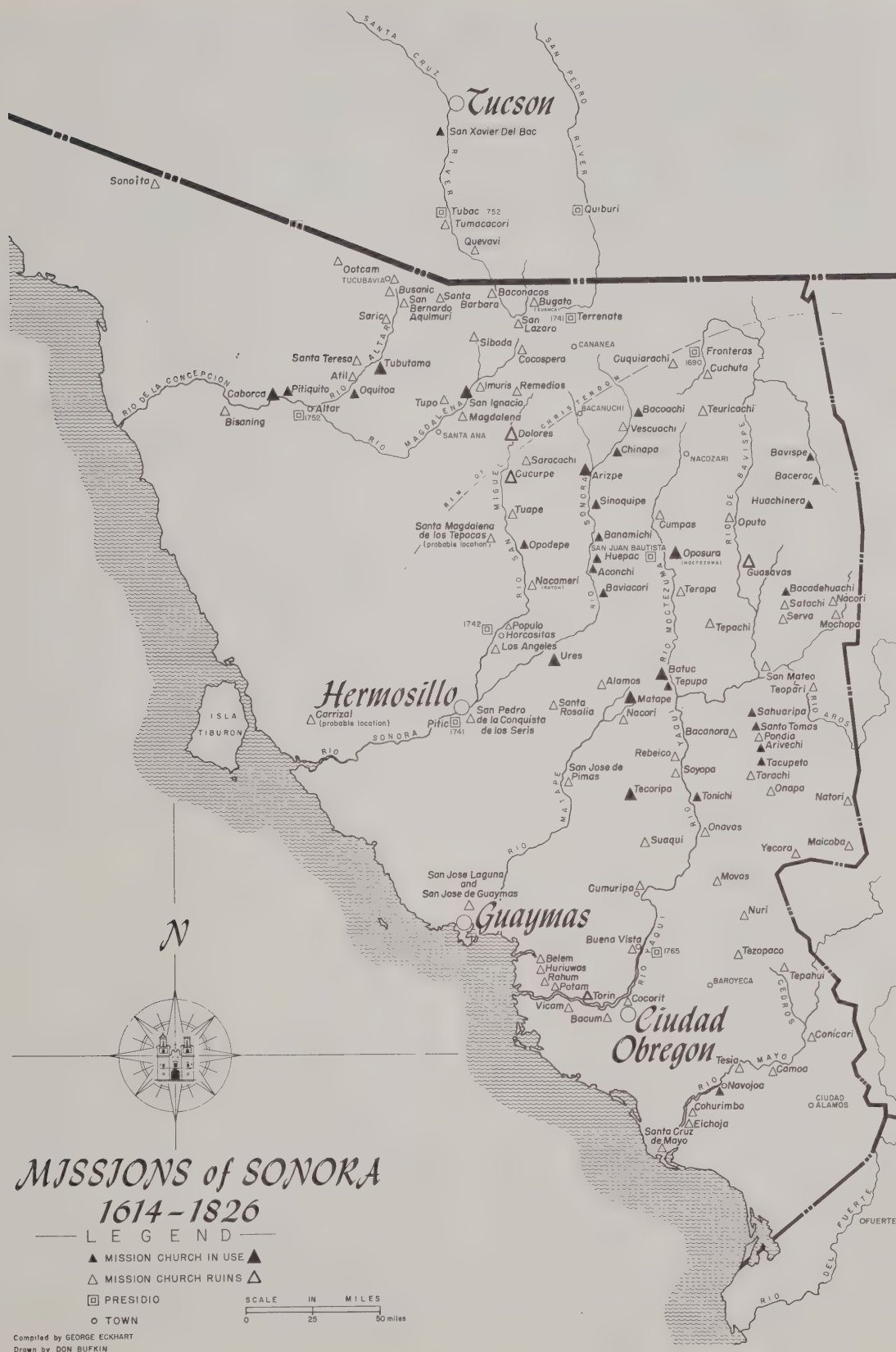


— Donald B. Sayner Collection

Map of Pimería Alta — from French reprint of Padre Kino's journal, found in Paris bookstall

at El Tupo, near present day Magdalena, for peace talks. Some of the soldiers, like their later Anglo-Saxon counterparts, believed that "the best Indian is a dead Indian." There then ensued what was long known in the history of Pima Land as La Matanza — The Slaughter. The Pimas thereafter did settle

down to peaceful ways, but for reasons other than the massacre at El Tupo. Fifty-six years later, in 1751, the Pimas were again to strike at the Spaniards, on both sides of the modern international border, bringing about far more serious consequences than the rebellion during Kino's day.



Kino was to found twenty-five missions, three of which, San Gabriel de Guébavi, San Cayetano de Tumacácori, and San Francisco Xavier del Bac, were to be in the Santa Cruz Valley, between Tucson and Nogales. There is some difference of opinion on the dates of the founding of Guébavi and Tumacácori, though it has been clearly established that San Xavier was founded in April, 1700, Kino himself taking part in the construction of the mission church. "On the twenty-eighth," he writes, "we began the foundations of a very large and spacious church and house of San Xavier del Bac, all the people working with much pleasure and zeal." But the beautiful "White Dove of the Desert," though bearing the name Kino had given to his mission, was built by the Franciscans in the closing years of the same century. Guébavi may have been founded in 1701, and Tumacácori a year or two later.

It was not until 1691 that Kino made his first *entrada* into Arizona, accompanied by one of his closest friends, Father Juan María de Salvatierra. They descended the Santa Cruz Valley as far as Tumacácori, and visited Guébavi. They were favorably impressed with the fertile countryside and the friendly natives; and in the following year Kino returned to the valley, visited Bac, where there was an Indian population of eight hundred, and then turned east to the San Pedro, which was then referred to as the Río de San Joseph de Terrenate, or de Quíburi. Thus Kino had begun his contacts with the northern groups of Pimería Indians, contacts which were to continue until his death in 1711 at the Sonoran mission of Santa María Magdalena. And it is most fortunate that he was to write a detailed account of his experiences and observations, under the title of *Favores Celestiales*, which was later translated by Bolton as *Kino's Historical Memoir of Pimería*. It is from these, together with the writings of the superb diarist, Juan Matheo Manje, who was often Kino's companion on the trail, that students have drawn most of their facts on the early history of southern Arizona.

For example, it was Kino and Manje who have given us our first written records of the famous Casa Grande, together with priceless accounts of the Indians and the land on which the natives lived. Along the lower Colorado, in 1699, they heard echoes of folk-tales which Oñate had listened to eighty-four years earlier. But they had a new one for Kino and Manje, though it was one which was rather common in many quarters of the Southwest. The tale

related to The Woman in Blue, who at one time had visited the Colorado people, dressed in white, grey, and blue, and who wore a veil. She spoke to them in a language they did not understand, and they shot her with arrows, leaving her for dead. But she came to life and "left by the air."

Kino had not gone to the Colorado to listen to yarns. He was much more interested in facts of geography, especially those relating to Baja California. As a young man, he had been taught to believe that Baja California was a peninsula. This, of course, was correct; but in New Spain he was told that there was no peninsula in the area, that California was an island. This Kino doubted, and by questioning the Indians and observing the Gulf coast he reasoned that his initial concept was true. To inform the world of his conclusions he drew the first fairly accurate map of the peninsula and the mainland in 1701.

Kino by no means was the only famous Jesuit in Pimería Alta. Padre Agustín de Campos, one of the ablest of linguists, reached Pimería Alta shortly after Kino began his work at Dolores, and for twenty-three years Campos followed the example set by Kino. Beginning in the 1730's bands of Jesuits with un-Spanish sounding names — Keller, Sedelmayr, Steiger, Nentvig, Rhuen — entered the Pima missions, and before the expulsion of 1767 many more were to arrive from Mexico and Spain. But, with few exceptions, very little is known about any of them. They still await their Herbert E. Bolton or Francis Parkman.

Between the time of the death of Kino and the expulsion of the Jesuits, there were two notable events which made their marks on the history of Pimería Alta. One relates to the discovery of silver; the other, to the Pima revolt of 1751.

A dozen or so miles southwest of the twin cities of Nogales is a site which is sometimes called Arizona. Perhaps the big state of Arizona owes its name to this small spot on the map. Everyone is not in agreement on the origin of the application of the state's name, but students of Southwest history all admit that the spot on the map, in 1736, was far more important than the vast area to the north. For it was in the Sonora hills at Arizona, which in the eighteenth century commonly went by the names of Arizonac, Aranzazu, or San Antonio de Padua, that one of the most remarkable discoveries in the mining history of the Southwest was made.

Late in October or early November 1736,



— Arizona State Museum

Mission at Caborca, Sonora. Restoration is now in progress on crumbling adobe walls

Antonio Siraumea, a Yaqui miner, while searching for mines in the hills near the settlement, discovered large nuggets and slabs of silver lying close to the surface. This set off a mining rush, the first of its kind on this frontier. The hills were soon swarming with hopeful prospectors, many of whom struck it rich — at least for a time. Word got around that the metal was virgin silver, a rumor which, in the main, proved to be true. This was a matter that needed official investigation, for the king's interests were at stake; therefore, the captain at the nearby presidio of Terrenate, Juan Baustista de Anza, father of the founder of San Francisco, hastened to the scene. Upon his arrival, he learned that much of the silver had already found its way into the pockets of many a Spanish storekeeper. Moreover, he was soon

to learn that no less than four thousand pounds of silver in the form of large balls and slabs, had been taken from a comparatively small area; and one such ball or slab was so large and heavy that it had to be broken into manageable pieces. Anza promptly placed an embargo on all the silver which had been discovered, for there was a highly important legal problem to be solved. If the silver was the product of normal mining procedures, the king would be entitled to one-fifth of it. If it were a treasure trove, as some believed, then the state might lay claim to all of it. And supposing the Aztecs had hidden it here on their march to the Valley of Mexico, a point of view held by many a frontiersman of the day. Yet, there was the possibility that God in His wisdom had cached the metal for the use of the missionaries,

so said some of the Jesuits. It was the Jesuits also who provided Anza with legal briefs on mining law. Fathers Joseph Toral, Cristóbal de Cañas, and Juan de Echagoyan, from their missions on the southern limits of Pimería Alta, in detailed and well-documented opinions, informed the captain that the discovery presented some knotty problems, but it was their belief that most of the silver belonged to the state. In effect, this was also to be the decision of authorities in Mexico City. Thus the discoverers were to be denied their claims to the silver. But this did not stop the silver rush, and doubtless many a hopeful prospector sunk his pick into the Arizona hills north of Arizonac. Yet there is no evidence that any comparable deposits of silver were found, and within a few months the prospectors set aside their picks and settled down to a more normal life.

Life remained normal until the early winter of 1751, when the Pimas once again rose in rebellion against their Spanish masters. The uprising, which began in November at Sáric, a mission in the upper Altar, was to be the most serious Indian revolt in the history of Pimería Alta. The causes of the uprising are none too clear, though it is known that Luis Oacpicagigua, native governor and captain general of the Pimas, had long been hostile to the Spaniards and was waiting for the opportunity to lead his people in violence against the white men. By November 20, he thought the opportunity had arrived, and instructions went out to all of his people to destroy the white man and all his property. Within two days, Father Tomás Tello was murdered at Caborca, and Father Enrique Rhuén and some of his servants were killed at the Papaguería mission at San Miguel de Sonoita. The revolt had also taken its toll in the Santa Cruz Valley and on the several scattered ranches. Father Francisco Paver, in charge at San Xavier and anticipating trouble, hurriedly made his way to Guébavi with three soldiers and his *mayordomo*. At Guébavi, Paver was joined by Father José Garrucho and others fleeing from the ravages of the Indians, and all retreated to the presidio of Terrenate. A few hours later San Xavier, Guébavi, and the Spanish farms at Arivaca lay in ruins. Meantime, down the Altar Valley at the mission of Tubutama, padres Jacobo Sedelmayer and Juan Nentvig, the latter of whom had escaped the hostiles at his mission of Sáric, were fighting off the attackers. Behind barricaded walls of Sedelmayer's house, the fathers and a handful of Spaniards and loyal natives succeeded in keeping the Indians at bay, though two

of the defenders were killed. After more than a day's fighting, Sedelmayer and his group made their way to a ranch at Santa Ana, and later moved to Mission San Ignacio. Thus, within three or four days no less than a hundred persons had lost their lives.

Reports of the uprising had reached the presidio and capital of Sonora, San Miguel de Horcasitas, where Governor Diego Ortiz Parrilla organized an army to subjugate the rebels. After nearly four months of campaigning, Oacpicagigua and his people, upon assurance that they would not be seriously punished for their deeds, agreed to return to their villages and to live in peace with the Spaniards. There was also to develop a serious quarrel between the governor and the missionaries, a situation quite common to the history of the Spanish borderlands. In this instance, in search for the causes of the uprising, missionary and soldier accused each other of being responsible for native unrest and rebellion. The facts of the quarrel reached the ears of the authorities in Spain, and, after some eight years of studying vast quantities of documentary records relating to charges and counter charges, the king's attorney ordered "that this matter be placed in perpetual silence." In other words, the royal authorities did not want to hear any more about it.

In order to maintain peace in Pimería, word had also come from Mexico City that a presidio was to be established in the heart of Pimería Alta. The word arrived in the form of a decree issued by the viceroy, dated January 31, 1752, with instructions that a force of fifty men was to be assigned to a permanent garrison, the site of which was to be chosen by Parrilla. On March 18, Parrilla ordered the founding of the presidio, though it was several months before the governor and his advisers made their final decision for the site of the military post, which was to be Tubac. The first commander of the establishment was the experienced frontier officer, Captain Tomás de Beldarráin; and Parrilla has left us the muster roll containing the names of these early Arizona pioneers.

Sixteen years after the Pima Revolt, but not consequent upon that event, came the expulsion of the Jesuits from all of the Spanish dominions. The causes for the expulsion are not well known, but the entire affair had tremendous repercussions, both in the Old and in the New World. On this frontier — Pimería — the Jesuit missions were assigned to the Franciscans, whose record of achievement matches that of the Jesuits. Among the more notable ones

who played a significant role in the history of Arizona during the Spanish period were Fray Francisco Garcés, an expert in Indian psychology and the beloved missionary at San Xavier; Fray Pedro Font, superb diarist and keen analyst; padres Juan Díaz, Matias Moreno, and Thomás Eixarch, all three of whom, together with Garcés, were to meet a martyr's death across the river from Yuma in 1781; and padres Francisco Escalante and Francisco Domínguez, both of whom were to cross northern Arizona in a famous expedition from Santa Fe in 1776.

Quite as important as this array of famous names were those of soldiers and colonists. Lieutenant-Colonel Juan Bautista de Anza, commanding officer at Tubac and son of a distinguished father who had also served his king in Pimería, explored a route to San Francisco in 1774, and in the following year, 1775-76, led a colony of 240 persons from Tubac and as far south as Culiacán to found the great city by the Golden Gate. It was a caravan of soldiers with their wives and three missionaries, two of whom, Garcés and Eixarch, stopped off at Yuma, while Father Font continued on to California and kept a detailed diary of the expedition. And of course Anza had not overlooked the essentials of logistical support, including such important items as 695 horses and mules and 355 cattle.

It must have been an impressive sight when, on October 23, the caravan moved out from Tubac and began its march up the Santa Cruz Valley. Eight days later Anza and his colonists were at the Casa Grande, where Font made a thorough study of the place and drew a ground plan of the ruins. He was deeply impressed with what he saw and amused with what he heard. The Indians felt compelled to relate the "true" history of the site. The builder of the Great House, said the local historian, was The Bitter Man, whose servants were the wind and the clouds, and whose pretty daughter was married to a good-for-nothing. This made for trouble, but eventually The Bitter Man managed to set things aright. Then came the The Drinker to the country, whose principal assistants were the Humming Birds and the Coyote. He, too, had his troubles. He became so angry with his people that he flooded their lands, burned their skins with the sun, and turned some of the natives into saguaros. For the record, Font wrote all of this in his diary, and more; but he says, "we laughed a little at these yarns."

The expedition made its way down the Gila to the Colorado, reaching the junction of the two rivers



— Arizona Pioneers' Society

Doorway, Mission San Ignacio — still in use

on November 28. Here they were greeted by Chief Palma, a long-standing friend of both Anza and Garcés. It was this Yuman chieftain, together with Father Garcés who on former occasions had visited the natives in the region, that had convinced Anza of the feasibility of an overland route to California. Palma had been rewarded for his faithfulness by a medal which Anza had given him in the previous year, 1774, when Anza and a party of soldiers passed through the Yuman villages on their initial reconnaissance from Caborca to Monterey. Palma now returned the honors by providing a fiesta in the best fashion, after which the colonists, with the exception of Garcés and Eixarch, were assisted across the river and continued their march to Monterey and San Francisco.

Eixarch and Garcés remained behind with instructions to await the return of Anza. Eixarch settled down to a serious endeavor to convert the natives; Garcés, who was happiest on the trail with Indian companions, explored up and down the Colorado. "Padre Garcés," writes Font, "is so fit to get

along with Indians, and go about among them, that he seems just like an Indian himself." He ate their food, no matter how disgusting it was to the more delicate palates of the Spaniards; and, as a psychologist, he carried with him "a linen print of María Santísima with Niño Dios in her arms, having on the other side the picture of a lost soul." Here was an effective visual aid. The Indians, said Garcés, had their choice, either follow the teachings of the Most Holy Mary, or become the lost soul on the other side of the picture. Usually, it was an easy choice to make.

Eixarch was not so ingenious, and went off in despair to Caborca, only to return a few weeks later to be present upon the arrival of Anza from California. But Garcés was not at the Yuma villages when the lieutenant-colonel reappeared on the banks of the Colorado. The friar had been exploring and showing his linen print to the natives. At the time of Anza's return to the Colorado, Garcés was in the California mountains and preparing to extend his peregrinations to the Hopi country and possibly to the Rio Grande Valley. Therefore, he set his course eastward, through the Mohave country, and reached the Colorado at a point well north of Yuma, just two weeks after Anza and his party had left for Sonora. Here Garcés employed guides and headed east through the mountains, intent on reaching New Mexico. No one has yet taken the trouble to mark out his route with care, but it is reasonable to infer that it must have been close to the Santa Fe Railway route as far as Peach Springs. In any event he reached the Hopi villages, and would have continued on to Zuñi had the natives been more friendly. His only choice now was to face about, but only after he had sent a letter to the missionary at Zuñi in which he urged the opening of a northern route to Monterey. This proved to be something of a coincidence, for at that very moment Father Escalante at Zuñi had the same plan in mind. Garcés did not wait for a reply, but turned west and reached Yuma on August 27, 1776, and September 17 he was once again back at his mission of San Xavier.

The year 1776, as every schoolboy knows, is an important date in the history of our country; but perhaps he does not know that this was also a year of some significance in the history of Arizona. Not only did Anza lead his colony from Tubac to found San Francisco while Garcés made his famous explorations, but it was also the year of the founding of Tucson as a Spanish pueblo and the date of the

Escalante expedition along the northern borders of Arizona. In July of that year, fathers Escalante and Domínguez, accompanied by a small band of soldiers and guides, left Santa Fe on a northwesterly course with plans to reach Monterey. They were forced to abandon their quest in the vicinity of present-day Provo, Utah, and then turned south, entering Arizona near the northern end of Lydel Wash on October 16. From then until November 24 they followed a winding trail along the north side of Grand Canyon, crossed the river just north of the present interstate line, made their way to the Hopis, and thence to Zuñi, which they reached on November 24. The Old Pueblo — Tucson — was founded in the same year, when orders were given to remove the troops at Tubac and station them at the old Indian settlement of Tuquísón. The transfer was in accord with plans for ultimately moving the frontier of settlement to the Gila and the Colorado. Moreover, Tucson was at a strategic location for checking the marauding Apaches.

The designs for establishing missions and a presidio at the mouth of the Gila had been suggested by the Jesuits, who at one time in the 1740's had visions of pushing the mission frontier as far north as the Hopi villages. But the Apache barrier north of the Gila, together with the historical claims of the New Mexican Franciscans to the Moqui country, checked these ambitions of the Pimería Jesuits. Finally, however, the Gila-Colorado suggestion was given official approval and support in 1780, when a small army of soldiers and their families, accompanied by fathers Garcés, Díaz, Moreno, and Eixarch, were sent to establish two missions and a presidio on the west bank of the Colorado. The sites for the three establishments were opposite the modern town of Yuma; but the Indians were no longer the friendly natives they had been a year or two earlier. Even Palma, who had been one of the Spaniards' staunchest friends, turned against the white settlers. The natives protested the manner in which the Spaniards seized the Indians' land; the Spaniards were angry at the exorbitant prices the natives asked for provisions. On July 17, 1781, the Yumas took matters into their own hands by massacring nearly all of the white settlers, including the four missionaries and Rivera y Moncada, a former governor of California. Punitive campaigns were made during 1781 and 1782, but with little tangible results. The Indians remained hostile, and Yuma, Anza's bridge to California, was closed for



— Arizona Pioneers' Society

Painted and sculptured altar detail of old mission at Cocospera, Sonora — still in use

the remaining years of the Spanish period.

During the closing years of the eighteenth and the opening decades of the nineteenth centuries, Spain's hold on Arizona was tenuous. The Hopi and Navajo maintained their independence. A handful of troops and civilians remained close to the walls of the presidio of Tucson in the face of Apache raids, while the missionaries at Tucson, San Xavier, Tumacácori, and Guébavi worked diligently but not always successfully with their native charges. Then came the 1820's when a new tide was setting in from the east: white men, with un-Spanish names — Pattie, Young, Williams, Robidoux — pushed down the Gila, thence up the Salt, the Verde, and the Colorado with traps for the beaver.

Primarily these were men from the St. Louis fur trade — Sylvester Pattie and his son, James Ohio, who recorded the times in his memoirs, *Personal Narrative of James O. Pattie*, Ewing Young, Bill Williams who worked along the Gila, and Antoine Robideaux, "king of the Colorado fur trade," who worked west to the Colorado from Taos, summer rendezvous of the trappers.

They came into *Apachería* — a term which might at that time have been applied almost to the entire present state of Arizona. In the thirties and

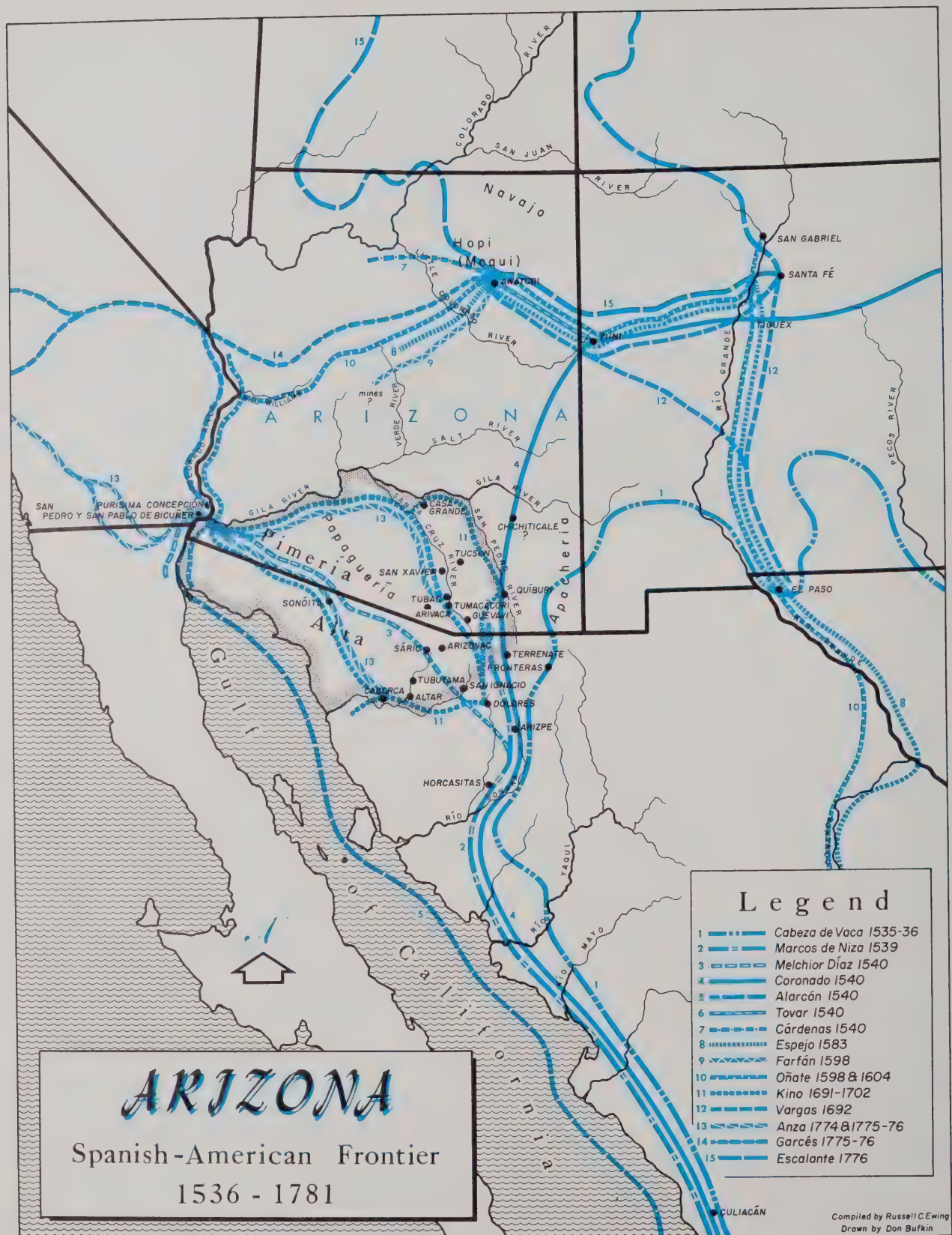
forties the area south of the Gila was almost wholly in Apache hands. The mission communities of Tumacácori and San Xavier had been deserted. White settlers remained only at Tubac and Tucson. North of the Gila was the wilderness home of the marauding Apaches.

The trappers and traders did not try to tame the wilderness, but adapted themselves to it, and to Indian ways, much as the French fur traders northeast on the continent had done in earlier years.

Apache wrath was not directed toward these *couriers du bois*, and the early relationships were not unfavorable. The Apaches were concentrated in the 1820's on keeping Mexicans and Spaniards out of the mining business, and from this concentration radiated much of the hostile energy that kept the generations at war.

In 1832, Juan José, elderly chief of the Mimbrenño Apaches, permitted Mexican miners at Santa Rita in southwestern New Mexico to remove large quantities of copper ore. This angered younger members of the tribe who moved to Warm Springs under the leadership of Black Knife. Joining with Mangas Coloradas in 1835, the younger group attacked the Santa Rita mine.

Subsequently the governor of Durango, Mexico,



made the error of offering bounty for Apache scalps, and fur trapper James Johnson fatally compounded this error by accepting the offer. He invited Warm Springs and Mimbrenño Apaches to a feast and a massacre, in which old Juan José was killed, and Mangas Coloradas escaped to wage war for thirty years with the support of most of the Apaches of the Southwest. Under his leadership such powerful subchiefs as Delgado and Victorio alternately stirred

and banked the embers that ignited the Apache wars of Arizona history.

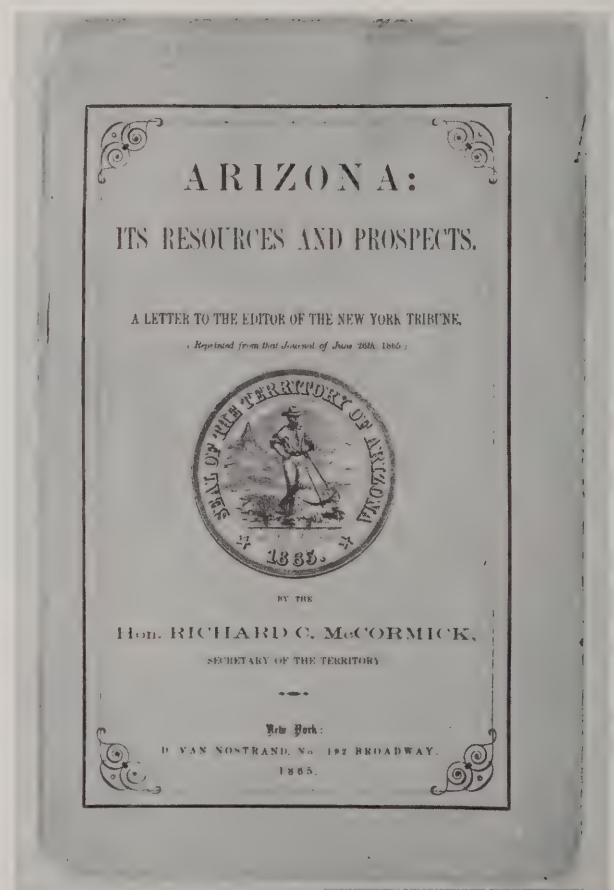
Such was the land of the Apaches in the days of the Mountain Men. These English-speaking frontiersmen carried with them the harbinger of another day, the day of Manifest Destiny. They were trail-blazers. Others that followed would soon have their chance to tame a wilderness which had vexed the Spaniards for nearly 300 years.



..... *the American past*

"THE ROCKY MOUNTAINS," SHOUTED A MEMBER of Congress in a heated debate in the early 1840's, "are mere molehills. Our destiny is onward!" Certainly the Democratic victory in the Presidential election campaign of 1844 was so interpreted by many. Upon assuming office, James K. Polk focused his attention on westward expansion. Texas, which had broken from the Republic of Mexico in 1836, was admitted to the American Union during the last days of Tyler's Whig regime. Polk and the Democrats wanted more. In their view, it was the "Manifest Destiny" of the American people to have a "universal Yankee nation" and "an ocean-bound republic." Their major objectives were the acquisition of the fur country of Oregon, controlled by British trappers, and the taking of the Mexican province of California. The British withdrew gracefully from the Pacific Northwest in the spring of 1846; but the Republic of Mexico, smarting from the loss of Texas, was not prepared to lower its flag from the slope of California where Spanish and Mexican banners had flown for almost a century.

To the people of Mexico, as to the Spaniards, land was a heritage and not a commodity. To American pioneers, it was something to be acquired quickly, used up, and passed on at a profit. Mexicans could no more understand the "land hunger" of Americans than Americans could comprehend the fact that Mexicans proudly held title to vast tracts seldom used or even visited. When President Polk sent a special agent to Mexico City in 1845 to negotiate the possible purchase of California — and the lands that lay between California and Texas — for as much as twenty-five million dollars, the Mexi-



— Donald B. Sayner Collection

Cover of a reprint from the *New York Tribune* by Richard C. McCormick, 1865

can government summarily rejected the offer. Some Mexicans demanded a war to punish the United



1865 map which accompanied McCormick's *Arizona: Its Resources and Prospects*

States for such insolence — and for the earlier acquisition of Texas. Polk and the Democrats may not have desired war with Mexico in May, 1846, but upon a convenient pretext it was declared. The Mexican-American War lasted almost two years, and actual hostilities continued until the fall of Mexico City to the American armies of Generals Winfield Scott and Zachary Taylor in September, 1847. Only incidentally did the campaigns of Scott and Taylor have a bearing upon California and the lands eastward to Texas. That phase of the war which affected the Far Southwest was President Polk's ambitious plan to occupy New Mexico and California, and possibly even Chihuahua and Sonora. Since the noted Army explorer, Lieutenant-Colonel John C. Frémont, was already in California with a band of American trappers and soldiers—and since American traders had been in contact with Santa

Fe for a generation — the prospect seemed bright.

At Fort Leavenworth, Kansas, Colonel Stephen W. Kearny was instructed to enlist an army for the Southwestern campaign. The "Army of the West" was a miscellaneous force: 300 regular dragoons, 500 Mormons sent by Brigham Young from his camp at Council Bluffs, a thousand rough Missouri adventurers, and enough Santa Fe traders and other travelers to make a total of more than 2,500. The Santa Fe traders brought 400 wagons with a million dollars worth of merchandise. Between June 5 and August 18, 1846, Colonel Kearney led his force the 800 miles over plains and deserts to the New Mexican capital. He occupied it without resistance, hoisted the Stars and Stripes at the Palace of the Governors, and proclaimed annexation. On September 22 Kearny established an American civil government at Santa Fe — the capital of a territory presumed

to include all of what is now Arizona — and immediately thereafter he set out with 300 regulars for California. Guided by Kit Carson, who was coming eastward from California, Kearny's dragoons crossed Arizona by the Gila River Trail, passing through the villages of the friendly Pima, and did not encounter the Mexican garrison to the south at Tucson. Lieutenant William H. Emory, leading Kearny's northern wing, arrived at Los Angeles in time to aid Frémont in the final conquest of California.

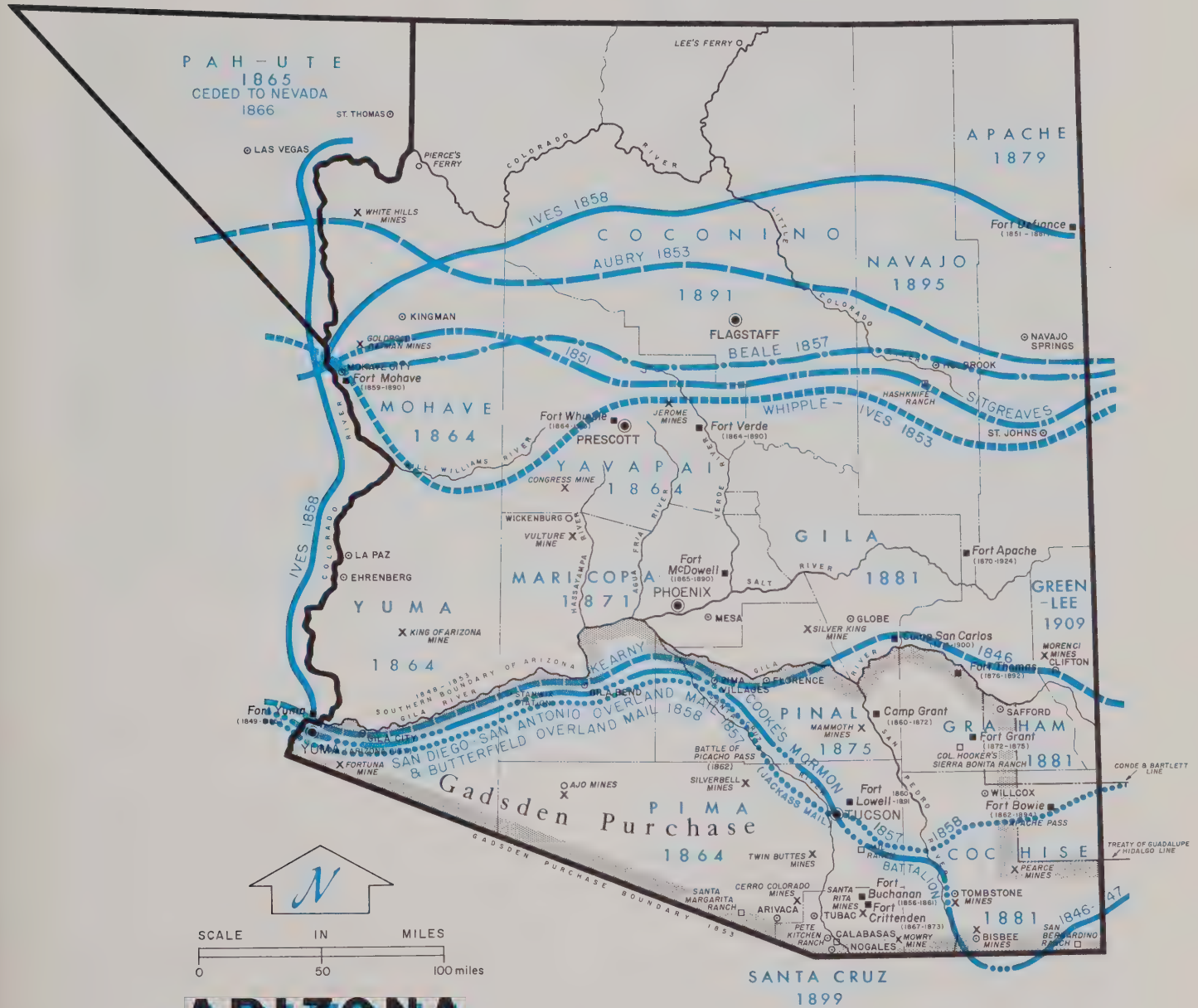
Of far greater importance in Arizona history was the subsequent journey of one of Kearny's officers, Captain Philip St. George Cooke, who led a caravan composed of twenty-four wagons, 397 Mormon men, and five women west from Santa Fe late in October, 1846. Cooke's guides were two veteran trappers, Pauline Weaver and Antoine Robidoux, who took the Mormon Battalion across the Continental Divide near Guadalupe Pass at the junction of the modern boundaries of Arizona, New Mexico, and Sonora. From Father Kino's old rancho of San Bernardino near modern Douglas, Cooke's wagon train proceeded down the San Pedro, descending it as far as modern Benson. Along the way, at the deserted rancho of San Pedro, the Battalion encountered several hundred wild cattle. As it happened, this "battle of the bulls" was the only notable action in which Cooke's force engaged on all its long march. The Mexican *comandante* at Tucson, Antonio Comaduran, obligingly evacuated the village before Cooke entered on December 17 and raised the American flag there for the first time. Cooke lingered only one night and left a note of apology for Comaduran. The captain was not impressed by Tucson.

Turning north, Cooke reached the Pima villages on the Gila in four days, and followed that river westward to its confluence with the Colorado near the present site of Yuma. Again Cooke was disappointed with the environment: "The country around the two rivers is a picture of desolation . . . Black mountains with wild-looking peaks and stony hills and plains fill the view." His wagons crossed the Colorado on January 9, 1847, and reached San Diego on the 29th. His party suffered much from hunger and thirst on its journey across the desert. Six months later the Battalion was dissolved at Los Angeles. Its role in the Mexican-American War was limited to this famous march, but the historical significance of the Mormon Battalion is great because Cooke's march marked the first route of a practicable wagon road across the Southwest.

The Mexican War was ended with the signing and ratification of the Treaty of Guadalupe Hidalgo near Mexico City on February 2, 1848. This important agreement ceded to the United States all of modern Arizona north of the Gila River, most of New Mexico, Nevada, and Utah, portions of modern Colorado and Wyoming, and all of California. The vast western expanse miscalled the "Great American Desert" for so many years, was now opened to occupation and development.

While it ended a bitter war, the Treaty of Guadalupe Hidalgo did not resolve all difficulties between the United States and Mexico. Article XI made the United States government responsible for preventing Indian raids into northern Mexico, but Apache depredations in Chihuahua and Sonora were heaviest in the years immediately following the treaty. Diplomatic friction was increased by the presence of several American filibustering expeditions on Mexican soil, and further by the persistent and aggressive claims of New York firms which held right-of-transit concessions across the Isthmus of Tehuantepec. The dominating problem, however, concerned the international boundary. While the 1848 treaty established the natural boundary of the Rio Grande as the international line from El Paso eastward to the Gulf of Mexico, it failed to provide a positive demarcation west of El Paso to the Pacific. The treaty stipulated no longitude or latitude; it merely declared that the boundary from El Paso to the Pacific shore should coincide with the line on Disturnell's map, which had been designated as the official map of the treaty. The choice of the Disturnell map as final authority was extremely unfortunate, for it was "an 1847 reprint of an 1828 plagiarism, of an 1826 reproduction of part of an 1822 publication."

When the joint Mexican-American survey party met in 1851 to locate landmarks on Disturnell's line, the map was found to be seriously inaccurate because El Paso was mislocated thirty-four miles too far north of its actual location. This gave Mexico an unexpected advantage which its commissioner, P. G. Conde, was determined to maintain. Conde's eventual compromise with the American commissioner John Russell Bartlett, was acceptable to the Whig administration of President Fillmore; but it was repudiated immediately by the Democratic expansionists who returned to office under Franklin Pierce in 1853. The Bartlett-Conde agreement was particularly noxious to the new Secretary of War, Jefferson Davis of Mississippi, because it meant the loss



ARIZONA

THE AMERICAN PERIOD 1846 - 1912

COMPILED BY WILLIAM A. DUFFEN
DRAWN BY DON BUFKIN



— Arizona Pioneers' Society

"Mohave Canyon" — Lt. Joseph C. Ives, *Report Upon the Colorado River of the West*. Washington: 1861

of some 3,000,000 acres in the Mesilla Valley west of El Paso. Furthermore, as a Southerner, Davis strongly advocated a "southern route" in the construction of a transcontinental railroad; he argued, and with good reason, that the most practical route to California was across the Mesilla Valley and then through the Gila River Valley of modern Arizona. Since the portion of the Gila Valley suitable for a railroad was in Mexican territory, Pierce and Davis began to consider the obvious advantages of a new treaty in which Mexico might make another large cession of territory to the United States.

Upon the urgent recommendation of Davis, the South Carolinian railroad promoter James A. Gadsden was sent to Mexico as United States minister in May, 1853. The major object of Gadsden's mission was to acquire all the territory needed for a transcontinental railway route — and as much additional land as President Santa Anna might sell. Gadsden was instructed by Secretary of State William L. Marcy to propose five alternative cessions to Santa

Anna, the largest to include all of Baja California, and he was authorized to offer as much as \$50,000,000. On December 30, 1853, Gadsden concluded a treaty with Santa Anna by which Mexico relinquished the Mesilla Valley and ceded 19,000,000 acres south of the Gila River. Other adjustments were incorporated: Article XI of the 1848 treaty was abrogated and Mexico agreed to drop all claims for depredations, and the United States would assume the Tehuantepec claims of New York speculators. The payment to Santa Anna's government was to be \$15,000,000.

Gadsden struck an admirable bargain, but his treaty became the subject of violent sectional debate when it reached the United States Senate. Northern spokesmen, fearing the possible extension of "slavocracy" into the new lands of the Southwest and still hoping to see a transcontinental railroad built elsewhere, argued that the lands were worthless. But pro-treaty lobbying by the New York speculators was vigorous, and Southern senators finally achieved

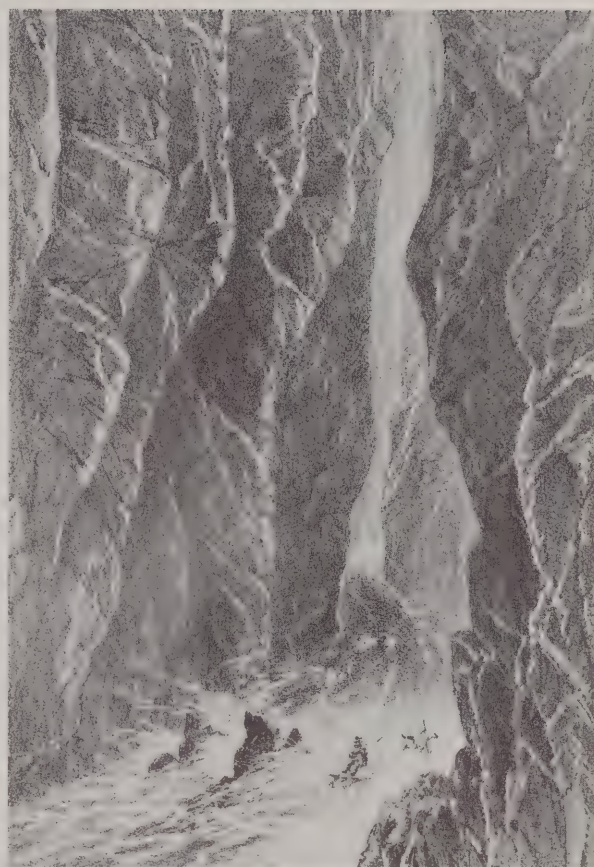
ratification by drastically amending the whole document. The revised version was approved by a close vote on April 25, 1854, but not until the payment to Mexico had been cut to \$10 million and the total area of the cession reduced proportionably. Santa Anna placidly accepted these alterations and the treaty was proclaimed on June 30, 1854. In Mexico the treaty was loudly denounced by Santa Anna's many rivals, and that veteran politician's career ended with banishment on a charge of high treason in 1855.

The widespread notion that Arizona failed to gain a port on the Gulf of California as a result of ignorance about geography among the treaty writers, or because of the surveyors' thirst for water and their alcoholic indulgences is unfounded. As finally ratified, the southern boundary of the Gadsden Purchase was a compromise, based largely on railroad survey reports, after six different boundaries were proposed to the Senate. Although the Senate considered including a Gulf port in the treaty, at no time had the Mexican government agreed to such a provision, and as a consequence no port was provided for in the final version of the Gadsden Treaty.

The Gadsden Purchase was the last contiguous addition to the domain of the United States. Properly it should be viewed as the final step in the Democratic program of "Manifest Destiny" which dominated the decade of the 1840's.

After the Mexican War, easterners turned their thoughts to the new land in the West. The settling of California dramatized the necessity of improving communications and narrowing the gap between the far-flung sections of the Republic. New routes, both by land and by water, needed to be explored. Moreover, there were now millions of new acres open for settlement if the Indians could be controlled. To the Corps of Topographical Engineers of the U. S. Army fell the task of performing the major portion of the exploratory work, and it was the Army that opened the hitherto unexplored rivers to the Democratic program of "Manifest Destiny" which dominated the decade of the 1840's.

In the fifties several well-equipped expeditions were sent by the federal government to locate a railroad route to the Pacific through Arizona. The leaders of these surveys were Captain Lorenzo Sitgreaves, Lieutenant Amiel W. Whipple, Lieutenant Joseph C. Ives, and Lieutenant J. G. Parke. Nearly all these exploratory and scientific parties crossed the central or northern part of Arizona near the



— Arizona Pioneers' Society

"Great Canyon of the Colorado" — Wm. A. Bell, *New Tracks in North America*. London: 1869

thirty-fifth parallel. Each expedition was accompanied by an escort of troops and a team of specialists who were keen observers. Almost every aspect of the region was carefully and minutely reported.

Soon the official reports of the expeditions were printed by the federal government. Many of these contain fascinating drawings. Today, such documents constitute a major source for Western historians who, of late, have grown more and more conscious of the magnitude of contributions made by these gifted amateurs. Many place names commemorate the men who took part in these early expeditions: Sitgreaves National Forest, Fort Whipple, Leroux Springs, and Bill Williams Fork, to mention a few.

A road-breaking reconnaissance across northern Arizona in 1857, under command of Lieutenant Edward F. Beale, surpassed in many respects the march of the Mormon Battalion through southern

Arizona ten years earlier. Beale was appointed by Secretary of War Jefferson Davis to superintend the construction of a wagon road which was to follow the 1853 Whipple survey along the thirty-fifth parallel from Fort Defiance to the Colorado River. He marked for the first time a practicable route that has been used from that day to this, and which became the pathway of the Santa Fe Railroad. Beale left Fort Defiance late in August and reached the Colorado about the middle of October.

To prove that the route was as good in winter as in summer, he retraced it, going from the Colorado to Zuñi in twenty-four days during January and February, 1858. His reports are as interesting to read as a novel. The most striking aspect of his expedition was the use of camels. Jefferson Davis sent ships to Africa and Asia to import camels for use on the American desert. These animals were disembarked at Indianola, Texas, and brought to San Antonio where Beale took charge of them. He could not express himself strongly enough on the merits of these noble creatures. While the experiment with camels in the Arizona desert failed to fulfill its earlier promise, reports of sighting these strange animals became part of the Western tall stories of later days.

The army was not alone in road-building in the New Mexico Territory. Jacob Thompson, Secretary of the Interior, shared Davis' desire for the location of a southern route to the Pacific. With the establishment of the Pacific Wagon Roads Office, a new era of road building began. The significance of wagon road building as a rehearsal of the railroad age to follow is definitively described in W. Turrentine Jackson's prize-winning book, *Wagon Roads West*.

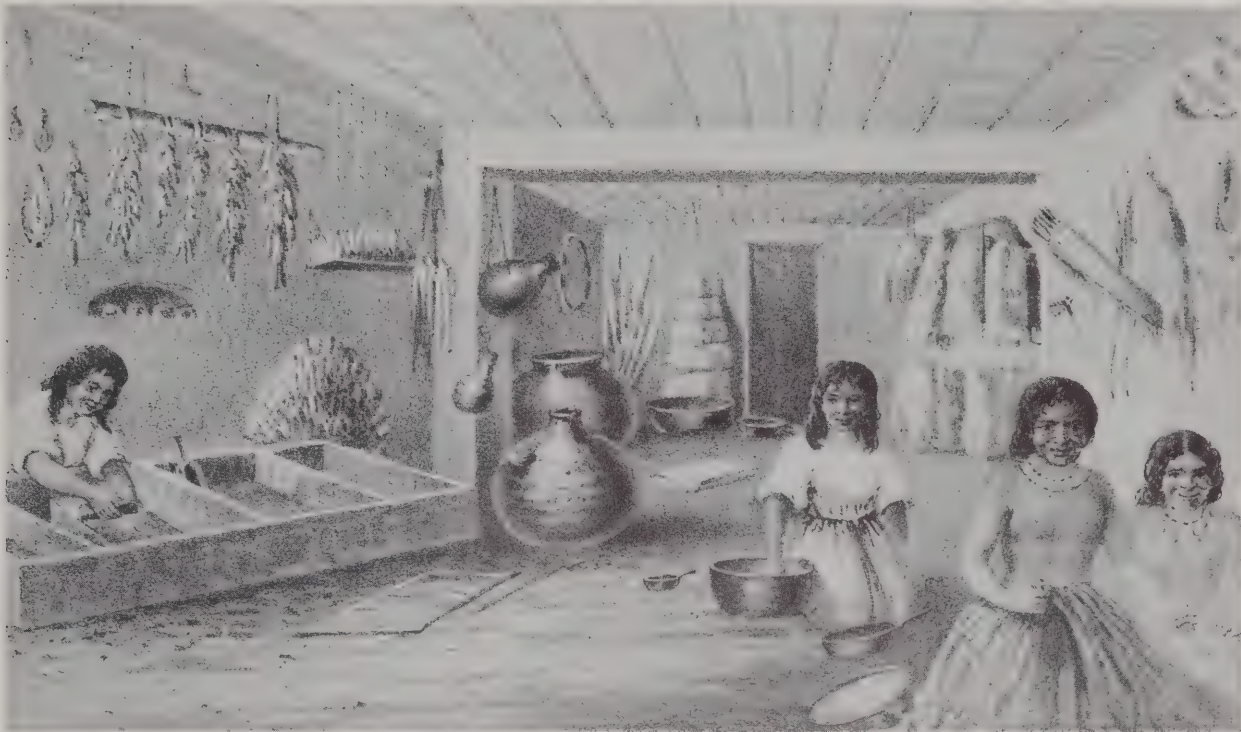
James B. Leach was selected superintendent of the road-building expedition to run from Franklin, a town opposite El Paso, Mexico, north to Fort Fillmore along the eastern bank of the Rio Grande. Crossing the river between the fort and the town of Mesilla, the road was to ascend the Sierra Madre Plateau to Cooke's Spring continuing westward across the Rio Mimbres. The survey was to run to Agua Fria, a watering place six miles south of the Ojo de Vaca. From these oases an old wagon trace was to be followed westward to the Railroad Pass by way of a pass in the Peloncillo Range. The area northwest of Railroad Pass was to be explored by the engineers in the hope of finding a shorter route to the San Pedro River. If this search failed, the road would run southwest by Croton Springs,

through Nugent's Pass, and due west to the San Pedro. From there, the valleys of the San Pedro and Gila rivers would be followed to Maricopa Wells. A direct westerly crossing to the small settlement at Tozotel, avoiding the Great Bend of the Gila, would be made and the river followed on into Fort Yuma.

Leach and his party left Memphis, Tennessee, on June 27, 1857, on this road-building assignment. The story of his accomplishments and difficulties is part of the neglected history of early Arizona. The financial chaos surrounding the Leach mission suggests that the Army Corps of Topographical Engineers was far better equipped to deal with road building in the Southwest, at this time, than were civilian agencies of the government.

While these various explorations and expeditions were in progress, that part of the New Mexico Territory later to become Arizona began to attract a number of settlers as early as 1854. Able and ambitious Americans now came to mine and to ranch and to engage in business at Tucson. In the summer of 1857 a mail and stage service — commonly called the "Jackass Mail" — was started between San Antonio and San Diego, and in the autumn of 1858 the Butterfield Overland Mail line was established between St. Louis and San Francisco. Charles D. Poston located the abandoned Ajo copper mines, organized the Sonora Mining and Exploring Company, and began intensive activities with his headquarters at Tubac. With Herman Ehrenberg, for whom the town of Ehrenberg was later named, came several Virginians — men of force and fire — influential both in council and battle: Mark Aldrich, the first American merchant in Tucson, the first mayor, and the first postmaster; Solomon Warner and J. B. (Pie) Allen, merchants; Charles T. Hayden, freighter, merchant, rancher, father of Senator Carl Hayden; Samuel Hughes, prospector, ranchman, and storekeeper; Hiram Stevens, trader and speculator; King S. Woolsey, ranchman, miller, and Indian fighter; Pauline Weaver, scout, trapper, and prospector. These men and many more like them occupied positions of influence and trust after Arizona became a territory, and to this day are accounted among the founders of Arizona.

In 1858 gold placers were discovered on the Gila River above Yuma, and immediately there was a rush to that region. Gila City came into existence almost overnight; within two years it had a population of 1,000. Gold to the value of \$2,000,000 was



— Arizona Pioneers' Society

"Interior of a Hopi House" — Lt. Joseph C. Ives, *Report Upon the Colorado River of the West*. Washington: 1861

taken out there. The boom at Gila City ended as suddenly as it began once the placers were exhausted. At this time, however, placer mining was common on the Colorado River, and Ehrenberg, La Paz, and Olive City sprang up overnight. Miners from Sonora and California flocked in, and for a brief time there were bonanza days. But, because of insufficient water for placer mining, and inadequate technology, operations abruptly declined.

Mining activity sprang up next at Hassayampa, on Big Bug and Lynx creeks, at Weaver's Gulch, at Antelope Hill, and in the region of which Prescott is now the center. The earliest Americans in this area were such trappers and prospectors as Pauline Weaver, Joseph Walker and his band, Jack Swilling, and Henry Wickenburg. At Richmond Hills \$100,000 in gold was picked up, and an equal amount in nuggets was gathered on Antelope Hill or dug from the rocks with pocket-knives. It is estimated that \$2,000,000 worth of gold was taken from Lynx Creek and Weaver's Gulch before the placer excitement abated. Later the region was found to be rich in veins and lodes of gold, silver, and copper.

California-bound emigrants were perhaps the

earliest Americans to bring cattle into Arizona. From about 1849 on, a 1,500 mile trail was followed from Texas to the Pacific shore. With the appearance of population centers in Arizona, and as a result of the demand by residents of mining communities, small numbers of cattle were sold. Earlier, of course, wild cattle were left to roam at will when Mexicans from Sonora abandoned their homes to the marauding Apaches. William H. Kirkland, William S. Oury, and a few other settlers introduced cattle-raising during the late 1850's.

Early Arizona settlers, whatever their interests or occupations, faced a series of problems with Indians. While the area had been won by conquest and purchase from Mexico, trouble with the major tribes plagued Americans from the earliest expeditions into New Mexico Territory until the end of the Apache wars in the late eighties.

The Navajo was the first major Indian tribe to challenge the newcomers' title to the land. The Navajo, in the early decades of the nineteenth century stood at the center of a melée of intertribal raids and wars in Navajo country — northwestern New Mexico, northeastern Arizona, and south-

eastern Utah. The Utes and Comanches were after them, and the peaceful Hopis and Zuñis took every opportunity to avenge years of attack. Each tribe coveted the others' sheep and many Indians preyed upon the flocks of the New Mexico ranchers. The Navajos turned nomadic. Eternal vigilance became the price of their vanishing liberty.

The whirling atoms of the Navajos' destiny began to fall into place as early as 1846, when General Kearny arrived in Santa Fe. Other Indian tribes responded to Kearny's friendly overtures, but the Navajos remained aloof. A good but misleading augury was a meeting between Navajos and the Missouri Volunteers, who tried to achieve peace with the tribe through the aged chief Narbona. The leaders of both groups were in harmony, but not always able to control their followers. A trifling incident — a demand by a soldier for return of a stolen horse — triggered old suspicions. Narbona was killed, and with him died years of possible friendship between Anglo-Americans and the Navajos.

Further attempts to achieve a permanent peace between the Navajos and whites were futile, not only because the Navajo had incurred the wrath of all their neighbors, but also because of the American army's efforts to halt Navajo raids. Finally, American soldiers had to be stationed in Navajo country, at what became Fort Defiance, and a civilian agent was assigned for the tribe.

These agents moved in and out of the troubled fort in the years that followed. They usually lacked knowledge, direction, money, and understanding, and often disagreed with the military. One agent, however, provided a few golden years for the tribe. Captain Henry Dodge, called Red Shirt by the Navajos, came to Fort Defiance. Ahead of his times, he used fulfillment of their material needs and an inspirational friendship to influence the tribe. He taught them blacksmithing, and kept them supplied with new-found desirables such as calico goods. He married a Navajo woman who became a link between her people and the Whites. Not long after, however, Red Shirt was killed by an Apache, and the Navajos again came under the heterogeneous influences of a series of inexperienced agents.

Against Navajo interests were not only the Whites—American and Mexican—but the "Enemy Navajos," and the Utes, worst enemies of all, now scouting for the United States with Kit Carson as their agent. At the beginning of the sixties, the Navajos made an ill-fated attack on Fort Defiance.

They were surprised when vengeance did not follow, not realizing that the American troops would soon be moving out of Fort Defiance to enter the Civil War in the United States. The area was in chaos again — Utes, Zuñis, and Hopis unleashed on the Navajos — every warrior bearing an individual grudge. Colonel Kit Carson was called in to bring order. He rebuilt Fort Defiance and set out with the help of Utes, Pueblos, "Enemy Navajos," and New Mexican ranchers, to round up the tribe.

In a remarkably bloodless series of forays, he starved rather than killed the Navajos, destroyed fields of grain, killed flocks, and drove hungry warriors to surrender. The first band came in September, 1863. In January, 1864, Navajo resistance suffered a master psychological blow with the entrance of Carson's men into Canyon de Chelly. As Ruth Underhill says in *The Navajos*, "At last the Navajos believed there was no hiding place for them . . . Kit Carson no longer needed to hunt the Navajos. They came to him. Sitting in his adobe shack at Fort Defiance, he spent the rest of the winter receiving delegations and explaining the advantages of surrender."

By March, 1864, there were 2,400 Navajos at Fort Defiance. Then began the famous Long Walk, a three-hundred mile march to Fort Sumner in southeastern New Mexico. There the Navajos began a bleak new life on the Staked Plain, the *Llano Estacado* of the Spanish, above the little Pecos River. In 1868, the Navajos signed a treaty of permanent peace with the United States, permitting return to their former homelands where their reservation was established.

The focus of Indian-White conflict shifted to the Apache Indians of southern Arizona. These ethnic relatives of the Navajos, who had not been unfriendly to Americans before the army attempted to prevent their raids into Mexico, were now also faced with the problem of survival. Their attacks against Americans increased in number and intensity in an effort to stand against the continuing encroachment on their lands. Consequently, there began in New Mexico, western Texas, and Arizona a series of conflicts that provided succeeding generations with a stereotype of Indian warfare in the Southwest, and darkened Arizona's history. For close to forty years the Apaches continued as the most important human element retarding the settlement of Arizona.

The Apaches were divided into many groups. On the southwestern border of New Mexico were the



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"Mohave Valley Camp Scene" — *Reports of Explorations and Surveys... for a Railroad, 1853-54.*
Washington: 1856

Mimbrenos with such chieftains as Juan José, Mangas Coloradas, and Victorio. West, in the Chiricahua and Dragoon mountains were the Chiricahua Apaches with Cochise as their leader. North in Arivaipa Canyon were the Arivaipa Apaches led by Eskiminzin. Further north and centrally located were the Coyoteros of the White Mountain area. To the west in the Pinal Mountains were the Pinalenos. In the Tonto Basin were a heterogeneous group of Yavapai, Yuma, Mohave, and Tonto Apaches, and in Tubac and Tucson, the "tame Apaches" or Apache Mansos. Groups to the west called Apache-Mohave and Apache-Yuma have been shown recently by ethnologists and archaeologists to be Yavapai and not Apache. There were also many subdivisions and smaller groups, most of them not friendly to each other.

The matriarchal character of Apache society was a significant factor in determining the outcome of their encounters with Anglo-American society. The Apaches had no male leaders except in times of emergency when one man would be selected to lead a war party. If unsuccessful, this man was not chosen again. Thus the scene of conflict between Apache and Anglo-American opened in a hetero-

geneous setting, characterized by American efforts at settlement and highlighted strongly by the figures of such outstanding Apache individuals as Mangas Coloradas, Cochise, and Geronimo, each responding in his own way to the pressures of conflict, each not always able to count on identical response in his followers. White men driving Apaches from their homelands provided the first discordant note in a descending scale of relationships. Others were to follow in rapid and close succession.

Specific Arizona incidents began to be recorded about 1848. "Tame Apaches" were found at Tubac outnumbering the Mexicans two to one. In 1849, Captain Horace Bell and the California Rangers in pursuit of outlaws found Tucson besieged by Mangas Coloradas who was persuaded to call off his warriors if allowed to kill seven Mexican cattle for a feast. Mangas said he kept his men from killing Mexicans for "if we kill off the Mexicans who will raise cattle and horses for us?"

Raids, kidnappings, vengeance, and punitive responses on the part of both Apaches and Whites characterized the 1850's. Such incidents led relentlessly to war. In 1854-55, Dr. Michael Steck was appointed resident agent of the Gila Apaches whom

he encouraged to learn farming, and to permit overland settlers to travel unmolested through Apache country. His ideas for mutual benefit — peaceful non-molestation of settlers in return for goods needed by the Apaches — spread to the Chiricahua Apaches near Apache Pass and the Arivaipa Apaches at Cañada del Oro. But Steck's plans were aborted completely by the thrust of the military into the Pinal Mountains and surrounding areas.

In 1861, United States troops had to leave the Territory to prevent Confederates from capturing posts and equipment. Civil War was on the land. Forts Mohave, Breckenridge, and Buchanan were burned. Only Fort Yuma remained. The Apaches reacted to these events by accelerating their raiding and plundering, in the belief that their earlier attacks had been responsible for the withdrawal of American forces. In a territory without military protection, white civilians now took up arms against the Apaches. King Woolsey, an Alabama ex-Confederate, mobilized Pima and Maricopa Indians to fight the Gila Apache. The Arizona Volunteers were established, but were ineffectual and soon were disbanded.

A series of department commanders who were able to accomplish little, now appeared in Arizona. Suggested treatments of the Apache problem varied from Generals Thomas and Sherman, "if you prefer, notify the settlers to withdraw the troops and leave the country to the aboriginal inhabitants," to General Ord who ordered his troops to "capture, root out, and hunt the Apache as you would wild animals." Intermittently expressed was the thought that adequate reservations might be established where the Apache could be induced to live peaceably.

Peripheral to the general chaos but influencing its character were difficulties being caused at this time by other tribes, the Yavapai in Tonto Basin and Verde Valley, the Hualapai further west, and the Colorado River tribes. The Arizona Department had its hands full.

A semblance of military order again came, in 1870, to the northeastern part of Arizona with the arrival of General Stoneman, later governor of California. Camp Apache was opened with hundreds of Indians coming in for rations. But to the south, military control was still ineffectual. Near Camp Grant on Arivaipa Creek a small reserve was established for a group of friendly Apaches led by Eskiminzin. The people were restricted to hunting and food gathering. In this peaceful setting and with

a minimum of control available, the stage was set for a tragic incident in Anglo-Apache history.

Near Tucson an excited rancher reported theft of his horse. On April 3, 1871, a group of 104 Americans, Mexicans, and Papagos, acting independently under the leadership of Jesús Elias and William S. Oury, went to the Arivaipa reserve while the men were out hunting, and murdered eighty-five old men, women, and children, also taking twenty-nine captives. Agitation from the East notwithstanding, all 104 men were acquitted at the trial in Tucson.

Spurred on by this incident and by the pressure of mining and other moneyed interests for a quick peace, President Grant established a "peace commission" to try to negotiate with the Apaches.

Vincent Colyer, the first commissioner, represented the eastern American who had a rising feeling of sympathy, engendered both by James Fenimore Cooper's storybook treatment of the "noble savage," and by a practical interest in achieving peace to promote exploitation. The ideas of Arizona settlers were the antithesis of Colyer's and he was not welcome, but made progress nevertheless, bringing some 4,000 Indians into reservations.

In 1871, General George Crook arrived in the Territory ready for war. He visited Fort Apache, found the Coyotero and White Mountain Apaches very peaceable, and was notified by Washington to undertake no campaigns. Another peace plan engendered about this time brought General O. L. Howard to Arizona. He was also treated coldly by settlers, but managed to arrange peace treaties between the Apache, the Pima, and the Papago, and a treaty with Cochise in 1872, making possible a reservation for Cochise's people in the Dragoon and Chiricahua mountains of their own country.

A long-range planner, General Crook regarded the Apache as misrepresented, and not guilty of all the villainies of which he was accused. Crook also grasped the sociological facts of the Apache's life — a choice of farming or stealing in a country which could not support him — and a strong disinclination to farm.

In the light of this understanding, Crook took to the field with friendly Apache scouts, Navajo, Opata, Pima, Yaqui, Pueblo Indians, and Mexicans, and five troops of cavalry. Crook developed a pack train service, learned to operate in rough country and made successful expeditions which resulted in the beginning of Apache surrender by early April, 1873.

Surrender meant survival. The Fort Apache and San Carlos reservations were set aside in the early seventies. Important captives were sent by Crook to Fort Apache where, surprisingly enough, the Apaches began to farm and sell crops and grain to military posts. This conflicted with the aims of federal officials and other white men to sell goods to the posts and the Apaches from the White Mountains were moved to the San Carlos area where nature did not permit such effective farming. This period was also marked by the death of Cochise in 1876.

During these years the United States Office of Indian Affairs faced the complex problem of 5,000 diverse human beings brought together on reservations. So divisive had the Apaches been, that amalgamation of them almost constituted an attempt to join enemies. The problem was further complicated by inept and dishonest civilian agents, some of whom took cattle consigned to Apaches, worked Indians on their ranches, and confiscated Apache goods.

Apache nerves were further strained late in the seventies by such events as a rush of miners to the McMullen District, a swarm of Mormon settlers into Graham Valley, diverting water from Apache farmers, and the discovery of coal with the attendant threat of settlers in 1881, west of Fort Apache. These incidents stimulated outbreaks, as also did the presence of the military, or the occasional failure of reservation Apaches to receive promised rations.

As the eighties began, conflict continued with Apaches devastating property, and the American troops killing Apaches. Countless runaways, pursuits, and recaptures punctuated the gloomy story of those years. In 1882, a major problem in hunting Apaches was solved by an obscure treaty with Mexico, permitting United States and Mexican soldiers to pursue marauding Indians into each other's territory across the International Boundary.

The final act in the drama of Apache war began in 1882. Chiricahua Apaches were fleeing the San Carlos Reservation, and such leaders as Natchez, Loco, and Geronimo were periodically breaking away. On stage again after almost ten years absence was General Crook. He gathered about him such men as Captain Crawford, John Bourke, Lieutenants Gatewood and Forsythe, and such scouts as Al Sieber, Archie MacIntosh, and Mickey Free, for expeditions into Mexico.

One of Crook's first moves was to help some of the White Mountain Apaches to return to Fort



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"Aravaypa Canyon" — Wm. A. Bell, *New Tracks in North America*. London: 1869

Apache, thus impressing others with the futility of continuing war. He also organized Apache scouts who became vital in later expeditions. As programs for irrigation and agriculture implemented the concepts of the reservation system, Apaches on the reservation began a peaceful existence. This was temporarily interrupted in May, 1885, when Geronimo influenced the Apaches to resist Crook's policy of prohibition, and the important chiefs, Geronimo, Natchez, Mangas, Nana, and Chihuahua with about 100 others left for Mexico. They were hunted down by Crook's men late in 1885, and formal surrender of the Apaches took place on May 27, 1886.

The intensity and perils of Indian wars tended in Arizona to minimize the far greater peril to the nation represented by the Civil War. In fact, with only a minor skirmish occurring in the Territory, the war in Arizona was little more than a fight for men's loyalties.

Historians generally agree that the Southwest was a pawn in the power struggle between the North and the South in the tense years before the firing on Fort

Sumter. After the war began, strategy dictated a decisive move for control of the Southwest as part of the national and Southern battle plans. For several months before the conflict hit the Far West, there were many doubtful border states that could not decide which side to join. Jefferson Davis, now head of the Confederacy, was approached with a number of plans that would incorporate these indecisive states. One such proposal was to take California. If successful, Missouri, Utah, and other states might join the South. Therein lay the role of Arizona and New Mexico in the Civil War, for these areas stood between the Confederacy and its hopes for taking the West. Another factor which decided Davis to push into Arizona was his belief that there was enough gold there to aid in the financing of the war. Undoubtedly, his earlier experience with the Southwest while Secretary of War strengthened such beliefs.

At the outbreak of the War Between the States in 1861, Arizona was merely a name often used to describe the southwestern part of the New Mexico Territory established by Congress in 1850. The principal American settlements, Tucson in the west and Mesilla on the Rio Grande, were largely Southern in sympathy when the War began.

In July, 1861, after the arrival from El Paso of Lieutenant Colonel John R. Baylor (C.S.A.) with 308 mounted Texans, Major Isaac Lynde (U. S. A.) abandoned Ft. Fillmore — opposite Mesilla — and moved his 450 troops up the Rio Grande in an attempt to join Colonel Edward R. S. Canby at Fort Craig. Baylor occupied Mesilla and proceeded to enlist several companies of cavalry, including one known as the Arizona Rangers. On August 1, Baylor proclaimed himself governor of the Confederate Territory of Arizona, “forever” separating it from New Mexico. Later in the same month, the citizens of Tucson cast their lot with the Confederacy, elected a delegate to its Congress, and petitioned President Jefferson Davis for troops.

In the fall of 1861, Davis instructed Brigadier General Henry H. Sibley to take his force of 3,700 men to the Rio Grande and reinforce Baylor. Sibley’s own hope was to march all the way to the Pacific and bring California under the Stars and Bars. He arrived in Mesilla from San Antonio in December, and in February, 1862, started north in pursuit of Canby.

In mid-February, Sibley sent Captain Sherod Hunter and 100 Arizona Rangers west to occupy

Tucson. Meanwhile, a Union force of 3,000 California Volunteers under Colonel James H. Carleton was proceeding eastward from Los Angeles with orders to reinforce Canby. Elements of the California Column soon reached Fort Yuma on the Colorado and sent scouts ahead along the Gila to contact private individuals for supplies necessary for the next phase of the plan. At the Pima Villages, a Union man, Ammi White, operated a flour mill. To these scouts White sold a large amount of grain, agreeing to grind it and store it for the Column’s use at a later date. These activities became known to Hunter, who at this time was holding Tucson. Hastening north to the Pima Villages, Hunter surprised White and captured him, along with the supply of flour. Since the flour was bulky and Hunter had no means of transporting it, he gave it to the Indians. Later, when the main body of the California Column came through, the Indians sold this same flour back to the Column.

Under the leadership of Captain William A. McCleave, an advance detachment of the California Column, not knowing that the flour mill was in Confederate hands, entered the mill and was captured. McCleave and White were taken to Mesilla and were later exchanged.

A larger body of Union troops by now had crossed from Fort Yuma, and was moving eastward. On arriving at the Pima Villages, they learned that the Confederates had, but a short time before, abandoned the area and were marching toward Tucson. Anxious to intercept them, two detachments of Carleton’s men were sent in pursuit. Under Lieutenant Barrett, twelve men attacked sixteen of Hunter’s Rangers. A sharp skirmish ensued, in which Barrett and two other Union men were killed, and three Confederates were captured, one of whom was wounded. This small action, which occurred on April 15, 1862, in the pass near Picacho Peak, involved not more than thirty men. Known as the “Battle of Picacho Pass,” the skirmish is traditionally accepted as the westernmost action of the War.

Having heard of Sibley’s defeat at Glorieta, New Mexico, on March 28, 1862, Hunter evacuated Tucson in May and started east toward Mesilla with some Confederate partisans. Other Confederates fled to Sonora when Carleton occupied Tucson.

Hunter’s retreat to the east was marred by several Indian attacks. Some Union troops hurried after the Rebels while others remained in Tucson to establish the original Fort Lowell on a spot now



— Arizona Pioneers' Society

"Baboquivari Peak and Papagos Country" — Wm. A. Bell, *New Tracks in North America*. London: 1869

occupied by Armory Park. On July 15, 1862, as Union soldiers moved through Apache Pass, they were ambushed by a large force of Apaches directed by Mangas Coloradas and Cochise. The Indians finally withdrew and the troops continued east. Less than two weeks later Fort Bowie was established at the pass to contain the Indians. This fort remained active until October, 1894.

In August, 1862, Hunter's Rangers joined the last of Sibley's defeated Confederates, and left the Territory, but the delegate of the "Confederate Territory of Arizona" continued to serve in the Southern Congress.

Poston, the indefatigable explorer, believed by this time that protection and aid by the federal government were necessary. He was the first individual to present an organized plan for the Territory of Arizona to Congress. At a meeting in Congress in December, 1862, he made friends with Lincoln and proposed his plan. An act of Congress provided

for a temporary government for the Territory of Arizona, approved February 24, 1863, but it was not until December 27, 1863, that the territorial officers appointed by Lincoln arrived in Arizona. Attended by a military escort to protect them from Indians, they set up the Territorial government on December 29 in a snowstorm at Navajo Springs.

The American flag was unfurled; Rev. W. H. Read, who accompanied the party, offered prayer; the oath of office was administered to the governor, the three justices, and the district attorney; and the governor's proclamation was read by Secretary McCormick. On January 22, 1864, the officers of government reached Fort Whipple, which had been established by General Carleton previously for the protection of prospectors and miners who had been congregating in that region in search of gold. In May the seat of government was moved to the little town of Prescott that was just being founded. The first session of the legislature convened at Prescott, Sep-

tember 24, 1864, and at last Arizona came under control of a strong civil government deriving its power and authority directly from Washington.

In the ranks of the California Column were many men who resided in Arizona after the Civil War and who exercised their influence in the affairs of the Territory. Among the men who came with the California Column and spent their lives here were Sidney R. De Long, freighter, post trader at Fort Bowie, mayor of Tucson, a legislator, and author of *History of Arizona*; James D. Monihon, at one time mayor of Phoenix; Captain M. H. Calderwood, who became Speaker of the Assembly; Captain John W. Owen, for whom the Grand Army post at Phoenix was named; W. F. Swasey, a resident of Globe; Lieutenant W. F. R. Schindler, who was in the government service at Prescott after the war, whose daughter married Captain William O. (Bucky) O'Neill; and Clark B. Stocking, government scout, deputy sheriff and deputy marshal in Tucson.

During the War years, the area north the Gila was sparsely populated. The area south of the river was settled by Americans. By 1870 there were small ranches in the Gila Bend area and land was put into cultivation for hay and wheat. In the Gila Valley around Solomonsville and Safford there were other small farming communities. In the Verde Valley there were similar settlements. Many of these ranches and farms were the major suppliers for government military installations and for Indian reservations. But it was in the area of Arizona's largest city today, Phoenix, that the heart of the agricultural center was to flourish. Jack Swilling, the ex-Confederate, organized the Swilling Irrigation Canal Company about 1867, enlarging upon the prehistoric irrigation ditches in the Salt River Valley. The early agricultural ranches in many cases were settled by pioneers who had arrived before the government surveyors and thus pre-empted the most desirable land. Under the Homestead Act of 1862, these pioneers were permitted to take up residence by means of possession. Another act permitting accelerated settlement was the Desert Land Act of 1877. Under the provisions of this act, a settler gained title to 640 acres of desert land providing he irrigated it within three years. The Carey Act, passed in 1894, permitted the Territory to select land and grant amounts up to 160 acres to settlers.

Irrigation projects, private and local, had existed as long as farming in Arizona. The broad base of modern Arizona crop farming, however, was the

Reclamation Act of 1902, which initiated federal government financing for reclamation of desert lands and was responsible for establishing the Salt River Project as the first of its kind in the nation. Roosevelt Dam, dedicated in 1911, and a series of other power facilities evolved as phases of this program.

The majority of the state's oldest towns owe their existence to the discovery and exploitation of the mineral wealth of Arizona. The gold and silver deposits that lured prospectors before the Civil War drew fortune seekers in even greater numbers after 1865. The Vulture Mine, with its rich veins of gold, was started by Henry Wickenburg in 1863. Two years later the town that was named after him came into being, settled by miners not only from the Vulture but from such other mines as the Congress, the Constellation, and the Mack Morris.

By the 1870's the miners began to turn their attention to copper, the mineral which existed in such large quantities and which hitherto had been virtually ignored. Following the filing of the first claim in 1877, the town of Bisbee in the southeast corner of the state grew rapidly, with such mines as the Copper Queen, Copper King, and Arizona Prince, and, later, the Lavender Pit, among the most renowned. By 1900 larger smelters were necessary and the townsite of Douglas, southeast of Bisbee, was laid out.

Shortly after Bisbee's founding, Ed Schieffelin located the rich silver lode at Tombstone, not far from Bisbee. Within four years Tombstone was a roaring mining town, the county seat of Cochise County, and was world famous for its Bird Cage Theater and the Crystal Palace Saloon. Tombstone's prosperity ended, however, with the flooding of the mines which began in 1886.

Many of the mining communities of the middle Gila Valley sprang up at about the same time. Near the junction of the San Pedro with the Gila, the copper mining town of Ray was founded in 1870, while the neighboring communities of Hayden and Winkelman were established a few years later, primarily as smelting and business centers.

The discovery of the Old Dominion copper deposit led to the founding of Globe in 1876. To the west of the Pinal Mountains Superior was established in 1900 to supply the needs of the miners at the Silver King Mine. After the Silver King was worked out, the Silver Queen mine and Magma copper body kept Superior alive. Intense real estate speculation after the turn of the century led to the



— Arizona Pioneers' Society

“San Francisco Mountains” — *Reports of Explorations and Surveys...for a Railroad, 1853–54.*
Washington: 1856

building of Miami, over the violent protests of near-by Globe. Speculation turned to permanence, however, with the establishment of the Inspiration Mine Company near the new community.

In the valley of the San Francisco River in the eastern part of the state, the immense copper deposits found there led to the beginnings of Morenci in 1871, and Clifton in the following year. Morenci is still an important copper-producing area, the smelter for which is located at Clifton.

The search for copper led north in the 1880's and by 1883 Jerome — Arizona's most famous almost-ghost town — began its precipitous building on the north slope of Mingus Mountain overlooking the Verde Valley. The United Verde mines produced fabulous amounts of copper, as well as appreciable quantities of precious metals, before the major lodes were worked out and Jerome began in 1925 to slip slowly down the mountain. The existence of Jerome led to the development of the smelter town of Clarkdale at the base of Mingus Mountain and stimulated the development of Cottonwood as a retail trade center in the Verde Valley.

Prescott, which enjoyed the prestige of being the

capital city of the Territory for some time, grew with the development of numerous mines in the surrounding area. These mines, of which the most famous was the Iron King, were generally small and produced metallic ores other than copper.

In the southwestern section of the state mining operations had been carried on spasmodically at Ajo for many years, but the copper mines did not become important until after 1885. The New Cornelia, now owned by the Phelps-Dodge Corporation is still an important producer of copper, and the open-pit operations there are among the largest in the world.

By the end of the nineteenth century, most of the important silver and gold mines had been worked out, and copper was beginning its rise to prominence in the Arizona economy. Since 1910 Arizona has been the nation's leading producer of copper as well as a producer of substantial quantities of other non-ferrous and nonmetallic minerals.

Arizona's growth as a ranching state parallels its increasing mineral production. The establishment of large-scale ranching operations contributed to the founding of many small communities whose primary purpose was retail trade.

It was not until some years after the Civil War that ranching became important in the Arizona economy. The great herds of cattle and sheep owned by the Spanish and Mexican ranchers had been killed or run off by the Apache. After the Gadsden Purchase, efforts were made to restock the area with cattle but in virtually every case the Apache made off with the herds.

At the close of the Civil War, Texas found itself with a plethora of cattle and no market for them, so thousands of head were driven across New Mexico and Arizona to beef-hungry California. Many of these herds, attracted by the lush grazing conditions, stopped permanently in Arizona. However, continued Apache attacks wiped out most of these also. During the years in which the army was engaged in suppressing the Apache, the problem of feeding the troops in Arizona was a serious one. To supply the army's needs, local Arizona contractors drove herds of beef cattle in from surrounding states and territories. Several of these contractors later became prominent Arizona ranchers.

By the 1870's most of the hostile Indians had been settled on reservations, and ranching operations began to flourish. The first permanent cattle ranch of any consequence was begun in 1872 by Colonel Henry C. Hooker at his famous Sierra Bonita Ranch in the Sulphur Spring Valley. During the next few years, most of the other important pioneer ranchers became established, among whom were such men as the Redondo brothers, whose cattle were the first in Yuma County; King S. Woolsey, who owned three ranches in central Arizona; William Middleton of Pleasant Valley; John H. Slaughter, who settled first at Hereford and then moved to the historic San Bernardino Springs site near the Mexican border; the Riggs family of the Sulphur Spring Valley; and the Vail brothers, who with John L. Harvey and H. R. Hislop, quickly established in Pima County one of the largest cattle companies in the Southwest.

Cattle ranching was not of major economic importance in Arizona, however, until the close of the 1870's, at which time economic, climatic, and range conditions combined to stimulate its development. Low prices in adjacent areas, a severe drought in California, and good feed in Arizona offered would-be cattlemen an opportunity to acquire a herd at relatively little expense with prospects for a good profit. At about the same time, barbed wire, the windmill, and concrete came into general use, facilitating the handling of range cattle.

The opening of new grazing lands in the less settled portions of the Territory was further stimulated by the building of the two transcontinental railways across southern and northern Arizona in the late 1870's and early 1880's. Arizona's most famous ranching operation — the Aztec Land and Cattle Company — secured from the Atlantic and Pacific Railroad vast tracts of land in the northern part of the Territory. This outfit, known locally as the Hashknife due to its brand, was for many years one of the largest cattle ranches in Arizona.

The severe blizzard which the prairie and mountain states experienced in the winter of 1886 gave further impetus to Arizona cattle ranching. Many ranchers, anxious to avoid repetition of that desperate winter, moved their herds of Texas and Mexican longhorns to the warmer climes of Arizona. The increasing size and number of herds led to overgrazing and the consequent deterioration of the ranges, and the cattlemen soon abandoned their habit of holding steers to maturity, selling instead to feeder-buyers. This procedure led to the development of the large-scale feeding operations on the fertile pastures of the Salt River Valley which are still carried on today.

The fortunes of the cattle industry have reflected the vagaries of price and weather. Arizona's eminence as a cattle-ranching state, while still considerable, is declining, due both to rising land prices and the increasing urbanization of many areas.

Although overshadowed by the cattle industry, sheep have also long been economically important in Arizona. The first sheep were brought into the region by Coronado, but they did not remain. Later Spanish explorers brought other herds, and the first permanent flocks in Arizona were undoubtedly driven in by Navajo Indians who had acquired them from the Spanish in New Mexico. The Navajos remained the key figures in Arizona sheep-raising for many years. The flocks became increasingly important to the tribe through the eighteenth, nineteenth, and early twentieth centuries, diminishing in importance in recent years. The first authentic record of sheep breeding in Arizona was that practiced under the direction of Father Kino, who brought flocks with him to the missions he established.

Arizona's pioneer herds of sheep were from New Mexico. They were small with a low wool yield but with rugged constitutions, well adjusted to their rugged environment. White men began raising these sheep in the Territory in the mid-1860's, following



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“Cascade of the Little Colorado” — Capt. L. Sitgreaves, *Report of an Expedition down the Zuni and Colorado Rivers*. Washington: 1853.

the Spanish-Mexican custom of sheep running which is still in use. The industry differed also from sheep-raising in the east because in Arizona it was and is a major enterprise, rather than a sideline.

From 1850–60, approximately 55,000 sheep were driven across Arizona from New Mexico to California. But the first sheep in Arizona belonging to a white man were introduced by Juan Candelaria, who drove them from New Mexico to a ranch near Concho. Northern Arizona sheep-raising began among white men in 1875. The first flock was brought to Mohave County by John Clark, a longtime resident of Flagstaff. Other sheepmen of note included William Ashurst and the Daggs brothers. Burgeoning of the industry came in northern Arizona between 1880 and 1890 when the transcontinental railroad was built. Previously wool had been carried to market by teams of oxen to Trinidad, Colorado, or points on the Colorado River for shipment east.

Until 1890 Arizona was open range country and one could drive and graze cattle and sheep onto any land except the Indian reservations without let or hindrance. It was this that was largely responsible for the sheepman-cattlemen wars, the most famous of which was the Tewksbury-Graham feud, or the

Pleasant Valley War. These feuds, which have been greatly exaggerated over the years, stemmed from disagreements over grazing rights.

The methods of sheep-raising in Arizona, as in other states in the West, have their origins in the age-old practices of European shepherds. With few exceptions, the shepherds in Arizona are of Basque or Spanish-Mexican descent, and their customs are those of their mother countries. Unlike the eastern United States, where flocks are kept in fenced pastures, sheep in Arizona are allowed to graze over large areas with the shepherd and his dog keeping watch over their movements.

Little known to most people are the seasonal drives of the sheep from their summer grazing lands in the mountains to the winter pastures in the Salt and Gila River valleys. These drives follow “drive-ways” whose boundaries were determined by a committee composed of both sheepmen and cattlemen. In October, when heavy frosts make the mountain regions unsuitable, the sheep are started on their long, difficult journey to the warm valleys. Moving in large flocks at a rate of five to ten miles a day, with a shepherd and his helper urging them on, the sheep make their way through dense forests, over unbridged rivers, and down precipitous slopes to

the foothills of the Bradshaw and New River mountains. Here the sheep remain until approximately February, when they are driven on the final leg of their journey to the pastures of the valley. In the spring, when the heavy snows have left the mountains, the trip is reversed. In the course of their trip the sheep have traveled between 200 and 300 miles, with a change in elevation of as much as 6,000 feet.

In 1886 the sheepmen gathered to form an organization to promote their mutual interests. Out of this grew the Arizona Wool Growers Association, the oldest such trade group in Arizona. This organization was to stand both the sheepmen and cattlemen in good stead when the problems connected with the creation of the forest preserves — now the national forests — arose a few years later. Many people sought to prohibit grazing of all animals on forest land and it was through the vigorous efforts of the Arizona Wool Growers Association, working closely now with the cattlemen, that the regulations were drawn which permitted the controlled grazing by both cattle and sheep still carried on in the national forests today.

The vital importance of transportation to link the expanding interests of Arizona to the rest of the nation was pointed up not only by the growth of the livestock industry, but by the needs of every Arizona enterprise that involved a flow of goods and manpower between east and west. Eventually this would mean *every* enterprise, for in the late nineteenth century, Arizona, while still the desert, was so markedly at the frontier of American progress that equipment and personnel had to be brought in simultaneously with the pursuit of almost every constructive effort. So it was with mining, with cattle and sheep, with the marketing of agricultural products, and always with the conveyance of necessities and manufactured goods to the growing population of the Territory.

The early surveys by government explorers in the 1850's through the 1870's opened the way for railroad transportation. The Civil War undoubtedly stood in the way of any extension from St. Louis westward until the War Between the States ended. But even so, by 1873, the Territory had a small private narrow-gauge line near the town of Clifton. On July 27, 1866, Congress passed the Atlantic and Pacific Company charter, establishing a route from Springfield, Missouri, to Albuquerque, to run from there along the thirty-fifth parallel of latitude to the Colorado River. The Atlantic and Pacific did not

reach Arizona, for by 1879, it was absorbed by the Atchison, Topeka, and Santa Fe Company; and this latter firm extended the railroad across the northern part of the state. After securing a charter from the Territory of Arizona on October 8, 1878, the Southern Pacific line began to cross the southern part of the state reaching Tucson on March 20, 1880, from the west, moving on to Benson, Willcox, and into New Mexico. The Atlantic and Pacific, managed by the Atchison, Topeka, and Santa Fe, began building westward from Albuquerque in May, 1880. In August, 1883, it had reached the Colorado River across from Needles. From that time on, two great railways crossed the state, connecting the East Coast to the Pacific: the Southern Pacific on the thirty-second parallel, and the Santa Fe, traversing the thirty-fifth parallel. From these two systems, many branch lines were run to such towns as Prescott, to the Grand Canyon, to Jerome and the copper mines. Subsidiary lines such as the Arizona Eastern Railway ran up the Gila Valley to tend to mining demands. By 1900, an entirely adequate system of railways crossed the state, permitting travel and rapid transportation of freight.

Even before railroads were serving Arizona, the settlers were receiving supplies from distant points through the initiative of pioneer merchants. These young men, some of them boys in their teens, often combined mining or ranching with selling food, clothing, and hardware to other miners, ranchers, or settlers.

The story of Arizona's early merchants is as colorful and basic as the narrative of any frontier enterprise. It is a story with continuity, demonstrated today by many of the same mercantile firms serving Arizonans under the name of the men who established them almost a century ago.

Although many intrepid individuals peddled "beans, blasting powder, and baby shoes" to remote corners of the Territory by wagon, mule, or river boat, Arizona mercantile history really begins with the Goldwaters from California — Michael and Joe — who opened the first store in La Paz on the Colorado about 1860. Michael bought out Joe and moved to Prescott. His sons, Baron and Morris, carried on the family business in Phoenix. Baron continued in his father's business and was the father of Barry Goldwater, United States senator from Arizona, and Bob Goldwater who now operates the stores.

The original Goldwater store was moved several times — to Ehrenberg, then temporarily to Phoenix,

to Prescott, and back to Phoenix to stay. Former branches included Seymour, Fairbank, and Bisbee, where the firm was a partnership, Goldwater and Castañeda. It was here that the famous Bisbee Massacre occurred. Present-day Goldwater stores are located in Phoenix, Scottsdale and Prescott.

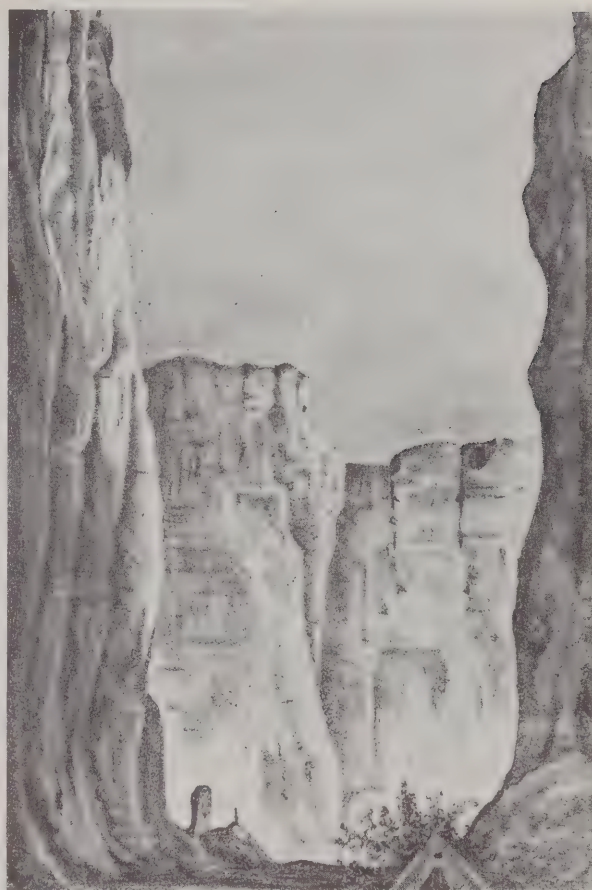
By the time the Southern Pacific Railroad reached Tucson in 1880, Steinfeld's was a going concern under the management of twenty-six year old Albert Steinfeld. This store served the community not only in dry goods, but in brick, lumber, and hardware as well. Albert Steinfeld was born in Germany and had his first job as a dry-goods store errand boy in New York when he was fourteen. When he was seventeen, at the invitation of his merchant uncle, Aaron Zeckendorf, he came to Tucson from Denver to work in the Zeckendorf store at Main and Pennington. Tucson's business section was a cluster of adobe huts in the shadow of the Apaches, and drinking water was five cents a pail from the only street well, called Elysian Grove.

Headed by Harold Steinfeld, son of Albert, the store celebrated in 1954 the dual centennial of Albert's birth and of the establishment of the first Zeckendorf store in Santa Fe. Other business firms having gradually developed in Tucson to supply the more specialized needs of the citizenry, modern Steinfeld's is a department store only.

Eugene F. Sanguinetti came to the Yuma area about 1882, from San Diego. He was fifteen years old and wanted to be miner. In addition to his mining ventures was his employment for five years in the mercantile firm of John Gandolfo, which then became Gandolfo and Sanguinetti. The early merchandising system of this partnership involved 400 mules used to distribute food, clothing and hardware to mining camps in the mountainous areas around Yuma.

The original Sanguinetti store was destroyed by flood in 1891. The present mercantile business is operated by a son, Frank, in the third building, erected in 1941.

David and William Babbitt of Cincinnati, Ohio, came to northern Arizona in 1886 to try cattle ranching in the Pleasant Valley area. They also cut timber near Flagstaff and there they were joined by a brother, George, who worked as bookkeeper for P. J. Brannan, pioneer hardware merchant in Flagstaff. The Babbitt brothers purchased Brannan's store in 1888, operated it as a general mercantile business, and in years to follow established branches in Hol-



— Arizona Pioneers' Society

"Canyon de Chelly" — Reports of the Secretary of War with Reconnaissances of the Routes from San Antonio to El Paso. Washington: 1850

brook, Williams, Winslow, Kingman, and the Grand Canyon, as well as setting up trading posts on Indian reservations in the northern part of the state.

The widowed paternal grandmother of the present-day Jácome family brought her children to Tucson from Ures, Sonora, Mexico in the mid-nineteenth century. Here she reared the family which included Carlos C. Jácome, founder of the Tucson enterprise. Jácome's first store, a partnership with Loreto Carrillo, was located on West Congress street and called La Bonanza. The move to East Congress came in 1925, and to the present building on Stone Avenue in 1951. The six sons of Carlos now own and participate actively in the management of Jácome's.

As these and other mercantile businesses of the state have developed and flourished, their founders

have been characterized by participation in state and community affairs. Morris Goldwater and Carlos Jácome were both members of the Constitutional Convention in 1910. Albert Steinfeld was the moving spirit behind the establishment of the Valley Bank, the Pioneer Hotel, farming areas in the Santa Cruz Valley and at Marana, and countless other enterprises. The Sanguinettis developed the ice manufacturing business in Yuma, went into banking, and were instrumental in bringing about the paving of streets in the Yuma area. The Babbitts have been notably active in the state legislature, the Board of Regents, and other state-serving organizations. Arizona's history of political development is highlighted throughout by the appearance of many names that are equally notable in the business directory of the state.

Arizona began to become politically important in the eighties. Until this decade the Territory was subservient to economic and political interests from the outside. Its minerals and pastures invited exploitation. Its federal appointive offices offered reward to less favored eastern politicians. Its remoteness and its expanses prohibited rapid settlement even after the completion of the railroads.

The opening of the mines, the development of agriculture, the extension of intraterritorial transportation, and above all, the national Democratic victory of 1884 aroused civic consciousness. The blunt refusal of President Cleveland to recognize Arizonans in making his appointments in Arizona fanned the flickering flame of statehood. Politicians wanting "Arizona for Arizonans" found ample support in their demands for statehood from those who felt that statehood would secure branch railroads, which would bring settlers with whom could be shared the burden of taxation. These ideas were formulated for the first time in a governor's message in 1889 by Governor Zulick:

"A territorial government, depriving, as it does, the citizen of full participation in the government under which he lives, is repugnant to the enlightened sense of the American people, and there is no question but that our progress would be more rapid and our prosperity would be quickened if these disabilities were removed."

The beginning of the nineties found Arizona interests hopelessly at variance with eastern demands for high tariffs and the gold standard. This did not deter enthusiastic citizens from meeting on October

2, 1891, at Phoenix to frame a state constitution. In this document they made statehood impossible by incorporating provisions for free silver and state aid for railroads and other corporations. Even the Republican press viewed statehood not as an end but as a means by which free silver might ultimately be obtained. Such were the forces throughout the nineties that kept active the statehood propaganda which took the forms of a called convention at Phoenix in November, 1893, of promises from the press that with the pending bills statehood was almost realized, and of a formal petition to Congress from the Republicans of Arizona.

This constant agitation was not without results; at least it produced a promise, for in the summer of 1900 the Republicans inserted a plank in their national platform advocating statehood for Arizona, New Mexico, and Oklahoma. This was a gesture that would tend to satisfy the sympathetic West until certain measures dear to the eastern interests had been safely written on the national statute books. In the meantime the clamor from Arizona for statehood was still louder, for with that achievement would come greater security to mining investments. At that time the future of copper seemed limited only by the amount of available capital.

Scarcely had the new century opened when Arizona became involved in a political storm centered east of the Mississippi which gave this western territory more notoriety than ever was connected with the admission of any other state. This disturbance was the political struggle between Senator Beveridge, chairman of the Committee on Territories, and Senator Quay, deposed political boss of Pennsylvania. Senator Quay conceived the brilliant notion of making himself champion of Arizona statehood, not with any apparent purpose of gaining statehood, but with the idea of building a machine with which to dominate the Senate; this he did for two years until his death in 1904. Around the issue of statehood he gathered not only western and recalcitrant Republicans, but even western and southern Democrats who were interested in additional western states. He held his obstructionist machine together by introducing from time to time resolutions asking that a date be fixed for voting on the House statehood bill. It was not good policy for Arizonans to grow restless with the delay but rather to applaud enthusiastically, never criticising but always hoping that out of these tortuous politics there might some day come a lucky break.



— Arizona Pioneers' Society

"Apache Pass from Camp Bowie" — Wm. A. Bell, *New Tracks in North America*. London: 1869

The lucky break, however, did not come; in its stead came another political trick that at one stroke converted the most ardent advocates of statehood in Arizona into its strongest opponents. This political miracle was accomplished by jointure, which provided that instead of four new states, two be admitted—Oklahoma and Indian Territory forming one, and Arizona and New Mexico the other. From the point of view of the administration this had two advantages. In the first place the conservative Senate would be diluted by only four western senators instead of eight; in the second place these four senators promised to be paired, the Oklahoma group Democratic and the Western two Republican. Two forces at once developed in Arizona against joint statehood. The first of these was directed by the vitally interested politicians. The new state, even though named Arizona as proposed, would be Republican. Those Arizona Democrats who had long looked hopefully to seats in the United States Senate at once turned every effort against the bill.

To make the prospect still more dismal, Santa Fe instead of Phoenix was designated as the capital of the new composite state. The most potent force, however, to be directed against jointure came from

the mining companies closely allied with the railroads, both of whom had controlled the Territorial legislature since their development within its borders. They saw their dominance at once dethroned by the addition of the large rural population of New Mexico. That meant that the corporations and not agriculture would bear the heavy end of the tax burden in the jointure state. Every effort was made to head off jointure. The corporation-owned press propagandized the masses into the passionate belief that jointure meant the end of Anglo-Saxon culture within the boundaries of Arizona Territory. A Congressional committee that visited the Territory was accompanied at various times by a total of five private cars of mining and railroad officials of Arizona.

Jointure was defeated by appeals to the interests of eastern investors. This defeat was accomplished without embarrassment to its advocates. In February, 1906, it was provided by Congress that the two territories settle the matter by a popular election in which rejection by either one of the territories would defeat joint statehood. It was a foregone conclusion that Arizona would defeat jointure and New Mexico accept it. The outcome was as predicted and Arizona's rejection concluded the episode.

For three years following the defeat of jointure ardent Arizona agitators worked for statehood. Conservative eastern interests fought for a longer lease of security by delaying admission till after the national election of 1908. Even so they appeared to be growing mellowed. The Republican platform, without inviting on this occasion recriminations of political trickery, advocated separate statehood for Arizona and New Mexico. President Roosevelt in his message of December, 1908, proposed immediate admission, but it was soon recognized that this would not come till after the inauguration of President Taft.

Just at this point a new and distinct group in Arizona became interested in statehood and gained remarkable cohesiveness. Labor had been at a disadvantage in Territorial days. As a group they had been unable to secure any favorable legislation because of the corporate control of the legislature. The many years of statehood propaganda roused in labor a new hope. If labor could write certain clauses in the constitution, if for example, labor had the constitutional authority to recall judges, they could then control the judiciary and override the dominance of the corporations. At first the labor group aimed at a separate party organization, but they were invited by G. W. P. Hunt to work with the Democratic party, being assured that only in that way could they carry out their plan.

This political bargain was not made under cover. Soon from conservative sources came veiled threats, mild at first, but growing in intensity with the passing months. The corporation-controlled press warned against using the constitution for legislative purposes. President Taft came to Arizona and warned in person. Again in a message in December, 1909, he urged conservative caution. After the people of Arizona had thus been properly warned, Congress passed the Enabling Act June, 1910, authorizing them in convention assembled to frame a constitution for their state.

As soon as the Enabling Act was passed, political activity again centered in Arizona. The contest was one between the various economic groups, disguising their efforts in part by political propaganda. Already the power of the Hunt organization, closely allied with labor, was understood. To offset this it was proposed that delegates to the constitutional convention be chosen without regard to party. That would make the issue one between economic groups where conservative factions might unite against

radical labor. Otherwise the issue would be one between political parties with the Democrats holding the large majority. Naturally, Democratic politicians had no future apart from their party, but the party leader had promised that the party if supported by labor would provide the recall of judges.

The next move on the part of the corporation delegates was an attempt to pry conservative Democrats loose from their party organization as separate issues came up in the convention. In this they failed, for that too would have meant political suicide for ambitious politicians. Arizona was at once deluged with threats and admonitions from the conservative press that a radical constitution would be vetoed by the President. A telegram of appeal to substantiate this warning was sent to President Taft. His answer was only a half promise, but that was enough.

In the face of ominous cautioning from the conservatives the combined Hunt machine worked perfectly and all the promised clauses — the initiative, the referendum, and the recall — were written in the constitution. The constitution had two gauntlets yet to run. In the first place, it must be approved by the voters of the Territory. This was done February 9, 1911, by a more than safe majority. There still remained the threatened presidential disapproval. Nor was this an empty threat, for the joint resolution providing for statehood was actually vetoed by President Taft in August, 1911. In spite of the veto, Arizona was verging on statehood. Within a week Congress passed a second joint resolution with the judicial recall deleted. This the President signed, and Arizona was a state.

While the events just narrated were occupying national attention, still another force involving a story too intricate to be related in detail was resisting the admission of Arizona. During the last decades of the nineteenth century Arizona, like eastern sections of an earlier period, had gone transportation mad. As a result of this hysteria three railroads had been subsidized by county bonds. The manipulations involving the Arizona Narrow Gauge Railroad Company had been especially scandalous. Although all the county bonds subsidizing the roads had finally been converted into Territorial bonds, both Pima County and Arizona had repeatedly resisted recognition of the Narrow Gauge bonds till forced to do so by the United States Supreme Court.

During the prolonged fight over statehood the eastern bondholders had sufficient political influence to delay admission of Arizona till 1,000,000 acres of

government land were presented to the proposed state to assure the payment of the interest and principal of the railroad bonds of several counties. Thus it came about that the bond question occupied no small place in the Congressional debates and in the meeting of the Senate Committee on Territories.

The admission to statehood could not possibly change the fundamental forces, the interactions of

which have been briefly outlined. There still remained the various factions within and the powerful interests without. The political history of the two decades of statehood is the history of the action of these same forces.

If history is prologue, these pages are merely an introduction to a great story — the economic, social, political, and cultural development of Arizona.



..... *the people today*

WHEN AN EASTERN VISITOR WAS TAKEN ON A TOUR of the Papago Indian Reservation recently, he was surprised to learn that there were no gate and no guard at the reservation line. A visiting scholar from Yugoslavia could not believe that Indians own automobiles. The most disappointed people are the tourists who expect to find "real Indians" in Arizona. There are real Indians in Arizona — more than in any other state — but they do not wear feather headdresses, live in tepees, or dance to tom-toms and wave tomahawks for the benefit of tourists.

Even among the real Indians of Arizona, with all their wealth of native (if un-Hollywood) ceremonies and customs, it is becoming increasingly difficult to find an Indian community where there are more Indians on horseback than in pick-up trucks, more native ceremonies than Sunday sermons, and more treatments by medicine men than by medical doctors. The rate of change is fast, and most tribes are in a hurry. Without exception, the primary concern of Arizona tribal leaders is to develop their economic resources and tribal enterprises and to effect other changes that will move the members of their tribes into an acceptable level of social and economic adjustment.

The Navajo, for example, have approved a \$10 million scholarship trust fund which will provide \$400,000 each year for Navajo boys and girls who want to go to college. Not only the Navajo, but Indians in every section of Arizona, now recognize the wisdom of the advice of the great Navajo leader, Manuelito. As he lay dying in 1893, he had this final word for the younger leader, Chee Dodge: "My grandchild, the Whites have many things which we

Navajo need. But we cannot get them. It is as though the Whites were in a grassy canyon and there they have wagons, plows, and plenty of food. We Navajos are up on the mesa. We can hear them talking, but we cannot get to them. My grandchild, education is the ladder. Tell our people to take it."

Tribal Differences

The influences of contact with White people, modern education, the reservation system, and other common factors are leveling forces which make it possible to discuss "Arizona Indians" as a group; but in fact, the differences from tribe to tribe probably outweigh the similarities. There are fourteen separate and historically independent Indian tribes in Arizona, most of them with their own language and culture. Among the fourteen tribes, three major linguistic stocks are represented, and these are as different from each other as English is from Chinese. Within the stocks, ten mutually unintelligible languages and dialects are spoken.

Aboriginal customs and traditions were almost as diverse, and these differences carry down to modern times, so that the level of understanding between a Navajo and a Mohave, for example, mostly depends upon that part of their knowledge, including the English language, which they have both learned from the surrounding American society. An Indian on a strange reservation can be just as much impressed and sometimes as much shocked at what he sees as can an American tourist. When a Cocopa Indian returned from spending a few days in the Hopi villages, he was full of news about his strange and, to him, aberrant hosts. Among other

things, he was awakened one night to learn that an old man had died in the home where he was staying. The next day the corpse was gone. Nothing was said about the matter, and there was no funeral. Such behavior was strange indeed to a Cocopa, whose religious life revolves around funerals and mourning ceremonies.

Individual differences among Indians are perhaps even more important. These differences relate to the amount of contact and education any particular Indian has had, but this does not always show on the surface. The situation of the cartoon Indian replying in perfect English to a question spoken in pidgin can be an embarrassing real-life experience for the unsophisticated reservation visitor.

Uniform Traits and Conditions

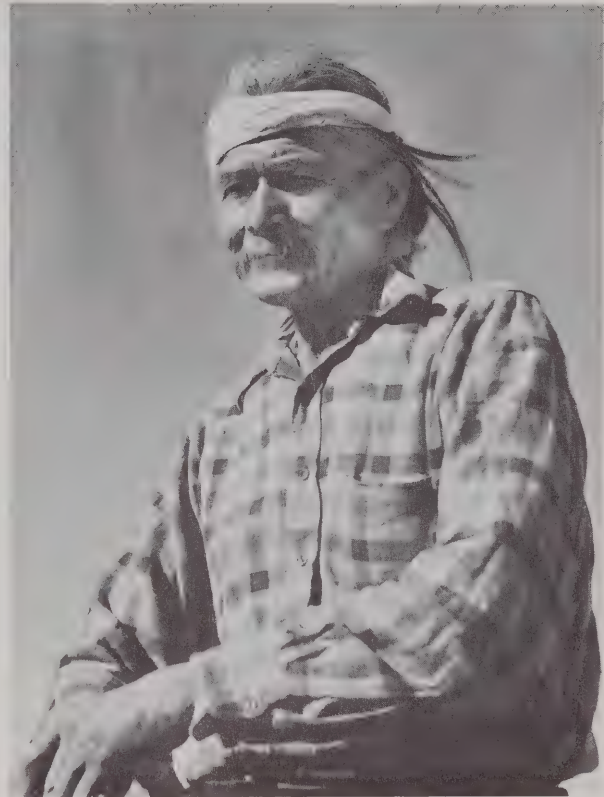
Recognizing and taking into account tribal and individual differences, there are nevertheless some basic similarities which have carried down from aboriginal days to modern times, and other similarities which have grown up as the result of White contact.

The outstanding trait of original similarity was the absence or weakness of the use of wealth as a symbol of individual or group attainment. The pursuit of wealth, therefore, had little meaning and, in the extreme case among tribes in the Colorado River Valley, was literally impossible in an earlier day. Among those tribes, custom decreed that upon the death of a family member, every possession of the survivors, including the home, its equipment, livestock, growing crops, and stored food be burned, destroyed, or given away.

Concepts of thrift, saving, and capital investment are among the most difficult for an Arizona Indian to accept and practice. Conversely, it is equally difficult for an American raised in the dominant cultural pattern to comprehend the absence of these concepts among the Indians.

The traits of perseverance, diligence, reliability, and the like are another matter. Contrary to popular opinion, the Indians of Arizona possess these traits in full measure; but they are associated with patterns of Indian life and not ordinarily with activities imposed upon the Indians by American society.

Similarities in Indian conditions and Indian life, however, mostly stem from the uniformity of experience with White settlers, missionaries, and federal officials and from the uniformity of the reservation system and attendant federal policies and programs.



— Tad Nichols

An old Navajo from Monument Valley

There are two basic aspects of life which underlie the unique position of Arizona Indians: (1) their lands are held in trust by the federal government, and as a consequence many aspects of their lives are controlled by federal officials; and (2) their tribes are "domestic dependent nations" outside and apart from our federal and state constitutional systems. The consequences of these factors are magnified in Arizona, where most Indian land is held by the tribe, rather than by individual Indians, and where Indian lands are intact, and not "checkerboarded" by non-Indian property.

The trusteeship relationship refers only to property; but associated with this has been federal management of Indian economics, and federal responsibility for such services to Indians as education, health care, loan programs, and others. This policy has given rise to a special Indian dependency upon federal administrators, and continuation of sentiments of resentment and distrust which were created in the pioneer days of Indian conquest.

The dilemma of the Indian is dislike for the existing system coupled with fear of losing it.

No one actually knows the social and psychological consequences of the trusteeship system. It is taken for granted by most non-Indians, however, that the over-extension of federal control of Indian property and Indian affairs so reduces Indian flexibility and initiative that it defeats the educational and other programs designed to prepare the Indians to live their own lives and manage their own affairs.

In the meantime, while Indian lands are preserved, normal development of resources and land is retarded. The "frozen" nature of Indian land ownership is illustrated on one reservation where the trusteeship system has brought it about that in one district, Indian farmers hold an average of twenty-five acres of farm land each with an average net return from farming of a little over \$300. To make a living for their families, the farmers supplement their income by means of periodic and seasonal wage work. The Indians cannot lose or sell their land, and they cannot make a living from it. The result is the perpetuation of an economy of "starvation" farming combined with low income wage work.

The other unique aspect of Indian life is the existence of tribes as "domestic dependent nations." Within the limits of federal statutes, Arizona Indian tribes have the right of self-government; and they have legal jurisdiction in cases, civil and criminal, which flow from their right to self-government. This brings it about that an Indian on a reservation in Arizona is a citizen of the United States and the state of Arizona at the same time that he is a "citizen" of his tribe. The paradox lies in the fact that he can vote in federal, state, local elections; but in certain matters he is subject to the jurisdiction of tribal officials and not state or county officials.

Level of Assimilation

The very great difference between the Indians of Arizona and those of most states is that they have mixed very little with non-Indians and have moved only recently toward acculturation and assimilation. This is largely because they have had fewer years of intimate White contact, greater geographical isolation, and, until recently, inadequate federal health and educational services. This is especially true for the tribes with greatest numbers: the Navajo, the Apache, and the Papago. The result is a high incidence of illiteracy, inability to speak English, a general lack of technological skills, high death rates, and a relatively low standard of living.

It is necessary, however, to put these statements

in perspective. A normal education program for Indians, the eradication of illiteracy, and adequate preventive and curative medical programs are in sight; and truly outstanding progress is being made by the Indians themselves in their effort to raise their own standard of living. The results of some recent studies confirm the rapid and recent change in family economics. The reason for this, particularly in the case of the Navajo, is a wholesale shift from dependence upon subsistence farming and stock-raising to off-reservation wage work. Thousands of Indian families during the past fifteen to twenty years have made this shift with the help of federal and state officials and, in some respects, in spite of the reservation system. Wage work is an obvious adjustment for a people who have limited reservation resources and who cannot cope with the American financial and business world, which includes modern industrialized agriculture. In this connection, it is necessary to distinguish between individual Indians and the tribal organization. Important natural resources on most Arizona reservations — such as timber, ore bodies, developed and undeveloped farm land, and oil fields — are held by the tribe and not by individuals. The tribe, of course, has access to trained men, Indian and non-Indian, for the management of tribal assets.

Our best data on Indian family income are from the Navajo and Colorado River reservations. There is no reason to believe that any tribe is worse off than the Navajo, and there are probably none better off than the Mohave and Chemehuevi on the Colorado River Reservation.

Most recent figures for the Navajo are for the year 1955. On the basis of an estimated 14,600 families residing on the reservation in Arizona, New Mexico, and Utah, with earnings of approximately \$35,374,000 from all sources, mean family income is computed at \$2,422 annually. Per capita income on the basis of 82,000 individuals is estimated at \$431. This compares with a mean per capita income for all residents of Arizona during 1955 of \$1,577.

The sources of total Navajo family income reveal a most surprising situation. Long regarded as making their living from agriculture and sheep raising, the Navajo now receive less than 12 percent of their total income from these activities. The largest share of family income, about 66 percent, is from salaries and wage work, on or off the reservation.

Differences in income as between Navajo families are not known for the reservation as a whole. How-



— Tad Nichols

Apache wickiup covered with beargrass. Canyon Day Apache settlement, Whiteriver

ever, a 1955 study of 100 Navajo families in the community of Shonto gives some indication of these differences. Twenty-two of the families had incomes of less than \$1,000 per year; fifty-two families, between \$1,000 and \$2,000; eighteen families, between \$2,000 and \$3,000; and eight families, between \$3,000 and \$6,000. The mean family income of \$1,548 for Shonto was much less than for the reservation as a whole.

A 1958 study of a sample of sixty-seven of the 203 families living on the Colorado River Reservation revealed that mean annual family income on that reservation was \$4,624. Mean per-capita income was estimated at \$858.

The sources of total income on the Colorado River Reservation once again reveal the importance of wage work. In spite of the fact that this is an agricultural community, about half of total family income in 1958 was from wages. Income from farming was 30 percent, and miscellaneous income was 7 percent.

The distribution of income among families was as follows: Of the sixty-seven families studied, three had incomes of less than \$1,000, thirteen families had incomes between \$1,000 and \$2,000, eleven families had incomes between \$2,000 and \$3,000, seventeen families had incomes between \$3,000 and

\$5,000, and twenty-three families had incomes of over \$5,000.

Tribal income has little or no direct bearing on family economics. Tribal profits are not distributed to individual Indians, but are used, in lieu of taxes, to finance tribal government, tribal welfare programs, scholarships, and reservation resources development.

Future Trends

The social and economic position of Arizona Indians will continue to improve in the future as it has in the past. The Indians themselves are demanding a better way of life; and the federal government, through the Bureau of Indian Affairs and the Public Health Service, is now prepared to offer services in keeping with Indian desires. Expenditures for the benefit of Indians in Arizona will increase as new Indian hospitals are built and Indian school enrollment, particularly in the high school grades, expands. During 1959 federal expenditures for Arizona Indians were in the neighborhood of \$30 million dollars. This compares with a total budget for all the Indians of the United States of \$26 million dollars as recently as 1944.

Movement off the reservations, which usually results in improved social and economic conditions,



Map showing the location of the Indian reservations in Arizona

has increased in recent years; and this trend will no doubt continue. A study of the Papago population indicates that approximately 60 percent of the families now earn their living in communities just beyond the reservation borders.

There is, however, no immediate prospect of any basic change in the reservation system. Some federal responsibilities for institutional services have been transferred to state and local government, and such transfers will probably continue. But there is no

TABLE I
ARIZONA TRIBES AND AGENCIES

<i>Jurisdiction</i>	<i>Reservation</i>	<i>Area in Acres</i>	<i>Tribe</i>	<i>Population</i> ^a
Colorado River	Colorado River	265,858	Mohave & Chemehuevi	1,395
	Fort Mohave	38,382	Mohave	374
	Cocopa	528	Cocopa	55
Total		304,768		1,824
Fort Apache	Fort Apache	1,684,872	Apache	3,738
Hopi	Hopi	631,194	Hopi	3,628
	Kaibab	121,000	Paiute	96
Total		752,194		3,724
Navajo	Navajo	10,816,996 ^b	Navajo	46,860 ^b
Papago	Papago	2,774,536	Papago	6,957
	San Xavier	71,090	Papago	517
	Gila Bend	10,297	Papago	200
Total		2,855,923		7,674
Pima	Gila River	372,022	Pima & Maricopa	5,546
	Salt River	47,007	Pima & Maricopa	1,403
	Fort McDowell	24,680	Yavapai & Apache	212
	Maricopa (Ak Chin)	21,840	Papago & Pima	139
Total		465,549		7,300
San Carlos	San Carlos	1,623,444	Apache	4,544
Truxton Canyon	Hualapai	997,045	Hualapai	641
	Havasupai	518	Havasupai	235
	Camp Verde	576	Apache & Yavapai	438
	Yavapai	75	Yavapai	54
Total		998,214		1,368
Grand Totals		19,501,960		77,032

^a. Population figures are estimates of the total number of tribal members on or off the reservations in Arizona. Many Indians living in the state are not on tribal rolls. For this reason the figures given here are probably conservative.

^b. Arizona only. Navajo reservation also includes 2,390,000 acres in New Mexico and 1,250,000 acres in Utah. The total Navajo population is about 82,000.

reason to believe that there will be an end to federal management and control of Indian property for many years to come. Indians in Arizona are almost universally opposed to that suggestion because they fear the loss of their property under private ownership, and because the trust arrangement carries with it property tax exemption, free medical care, and many other special benefits.

This being the case, federal officials and Indian leaders will be placed under increasing pressure to devise ways and means of developing Indian resources and enterprises under the existing trust arrangement. The growing economy of Arizona will demand that better use be made of Indian lands; and the Indians themselves, seeking a higher standard of living, will take an increasing interest in the management of their affairs by tribal and federal officials.

Other Ethnic Groups

The story of Arizona's settlement by a variety of ethnic groups does not really begin until the early eighteenth century with the establishment of the mission chain under Father Kino's leadership. The Spanish conquistadores, of course, were here in the early sixteenth century, but they did not accomplish effective settlement. Needless to say, Indian peoples were here long before, but are discussed elsewhere in this book and in greater detail, as their lives form the ancient background of the total story.

With the coming of the missions, people from Mexico began to settle in the Arizona region. True, they had a very small percentage of pure Spanish ancestry, but they were nationals of a neighboring country and the term Mexican was correctly applied to them in 1700, as it is today. Those who have come to live in the United States and are citizens and their descendants, are properly called Mexican-American.

This compound term is applied also to the other strains woven into the ethnic tapestry. Anglo-American, Indian-American, Negro-American, Chinese-American, and Japanese-American all denote immigrants or their descendants who are citizens. Since the term American applies uniformly, it is dropped for convenience in ordinary usage.

Mexican-Americans form about 30 percent of the population of Arizona today. The largest concentration of this ethnic group is in Maricopa and Pima counties, with Cochise, Santa Cruz, Yuma, and Pinal counties following. Among communities, the largest proportional concentrations of Mexican-

American populations are in Tucson and Phoenix and small cities on the border such as Nogales and Douglas.

A variety of activities, some military, some religious, but for the most part relating to Arizona's mining and early agriculture, have been bringing people from Mexico to Arizona for almost three centuries. This began late in the seventeenth century when the Spanish established missions and ranches in the upper Santa Cruz Valley. Most northern of these, and still in daily use by the Papago Indians, is Tucson's San Xavier del Bac, founded by Father Kino as a *visita* in 1700. *Visit*as were originally conceived as mission stations separated by a day's travel and thus able to be served by the priest of the controlling mission.

In 1757, a religious center was established at an Indian *ranchería* on the Santa Cruz, served as a mission for a time and then became a *visita* of San Xavier. The presidio and mission which later became Tubac were established by the Spanish on the Santa Cruz in 1752, and 1776, the presidio was transferred to the site of Tucson. This walled fortress was the beginning of the present metropolis.

In the area of the Hopi villages of northeastern Arizona, the Spanish had established three missions and two *visit*as in 1630. These were the only Spanish settlements in any number away from the southern part of Arizona.

Mexican troops and Mexican settlers were a part of the life within Tucson's walls from 1776. When the first English-speaking settlers arrived in the nineteenth century, the population of Tucson had spread beyond the presidio walls. By 1900, the English-speaking population had exceeded the Mexican for the first time.

Settlement of the Salt River Valley in the 1860's and later, brought Mexican people principally as agricultural workers. After the construction of Coolidge Dam the Mexican-American laboring people moved into the areas now known as Coolidge, Eloy, and Casa Grande. Irrigation farming brought the Mexicans also to the Colorado River Valley south of Yuma.

Mexican-American people settled in Cochise County primarily in the Douglas area and probably because of the copper smelter located there. Other mining areas, and work in the cattle industry account for additional Mexican population in Cochise County.

Mexicans in the state of Arizona, however, are



— Tad Nichols

Apache woman making a *Tus* or water bottle

not limited to the agricultural and mining industries. In the metropolitan areas and in smaller communities, they are present at all levels of the occupational structure.

The first Anglo-American people to take up residence in Tucson arrived in 1854. The Civil War temporarily slowed the rate of settlement by these people, but after the fighting was over, a second and greater wave of American settlers came into Arizona and persisted well into the twentieth century. In fact a majority of Arizona's towns and cities had been established before 1900, so rapid was the influx after the end of the Civil war.

The eighties were marked by an upward swing in the rate of Anglo-American settlement. In these years practically all of Arizona's Indians were placed on reservations. Somewhat as a consequence of this, the cattle industry was rapidly expanded under the leadership of American settlers.

Mining — especially for precious metals — accelerated in the sixties and seventies, with many of the important copper mines in Arizona developed in the 1870's and 80's. Although a large proportion of the mining laborers who came into the Territory

were Mexicans, later there came Europeans, especially from the Slavic countries, and some British.

The Mormon people were another Anglo-American group of settlers significant in the development of the state. In the early seventies they began moving into northern Arizona, moved up the valley of the Little Colorado and established communities on the north and west slopes of the White Mountains. Later in the decade they pushed south, establishing in the Gila River Valley in the Safford area, and in the Salt River Valley in the Mesa area.

The first Negro-Americans to become residents of Arizona were those who came to Tucson sometime between 1850 and 1855. However, it is apparent that the Negro population of Arizona increased very slowly until the period of World War I. The wartime demand for cotton called for an increased labor force. This was partly permanent and partly transient. Many Negro families took up permanent residence in the agricultural areas of Arizona. Others were in and out of the state as part of a transient labor force.

World War II also created a heavy demand for cotton, and again large numbers of Negroes moved into the state to meet the demand for laborers. Negro soldiers received military training in Arizona, especially at Fort Huachuca. Many of these Negro trainees liked Arizona so much that they returned with their families after the close of the war. It is evident that the Negro population of Arizona increased considerably as a result of World War II.

The 1950 census showed Maricopa County to have by far the heaviest concentration of Negro population followed in order by Pima and Pinal counties. These three counties have been and are the largest producers of cotton.

Chinese immigration to Arizona is not well-recorded, but closely parallels the history of the Chinese in Tucson. The first Chinese arrived in Tucson in the late 1860's, but the majority of the early Chinese immigrants came in about 1880 with the eastward extension of the railroad from California. They worked for the railroad as laborers, and to some extent as cooks. After the period of railroad construction, the mercantile business finally claimed most of the Chinese, particularly as operators of food markets. A smaller number have opened restaurants.

During the last decade there were 934 Chinese living in Maricopa County and 637 in Tucson, with a very few living in all counties but one. From 1910 to 1950, the Chinese population increased in ten of

the counties and decreased in the other four. Both metropolitan Phoenix and Tucson show a steady increase for this group.

The Japanese-American group in Arizona began around 1900, when the census shows the largest numbers of them in Coconino, Mohave, and Yavapai counties. The Japanese in Coconino may have been associated with the lumbering industry and mining camps and in Mohave and Yavapai with mining also. In all three counties they cultivated truck-gardens and worked in domestic service.

Around 1920, the Japanese began to concentrate in the Salt River Valley, south and southeast of Phoenix and in the area of Glendale. They engaged in farming and gardening and some of them specialized in raising flowers and fruits, particularly citrus.

In 1941 with the outbreak of World War II, the Japanese in Arizona were placed in concentration camps, two of which were located in Arizona. After the war they returned to the Salt River Valley and to some extent to the Glendale area. Today the stocks, sweet peas, and carnations of the Japanese flower farms glow among thriving fruit orchards, southeast of Phoenix and particularly along Base-

line Road. Many of the flowers are raised for seed.

In 1950, Maricopa had 416 Japanese residents and Pima County only nineteen, indicating a specialization in the activities of Japanese-Americans which led them to establish in the Phoenix area.

With Mexico at the border providing a reserve of labor, and the Indian people already on the scene, the building of Arizona has not called for large-scale immigration by a variety of ethnic groups. The immigration that did take place was primarily brought about by special needs and people with special skills necessary to fill them.

Present-day settlement, however, cannot be discounted. Especially in southern Arizona, there is a steady influx of health-seekers and retired vacationists, a surprisingly large proportion of whom become permanent residents. Also there is a seemingly irreducible minimum of healthy, employed Easterners, young and old, who have always wanted to live in the Southwest and finally do. This group, preponderantly Anglo-American, includes a large number whose specialized skills are highly useful to the manufacturing concerns which are establishing themselves in Arizona in increasing number.



..... its land and resources

*As light and the day are free to all men
So nature has left all lands open to brave men.*

TACITUS

..... *physical environment*

BOUNDED ON NORTH, EAST, AND SOUTH BY UTAH, New Mexico, and Old Mexico respectively, and on the west and northwest by California and Nevada, Arizona has a maximum north-south length of 392 miles and a greatest east-west width of 338 miles. Arizona includes an area of 113,956 square miles. Within that area is a spectacular range of contrasts in elevation, scenery, climate, and vegetation. Desert vegetation and sand dunes near Yuma line the banks of the Colorado River, whose perennial flow of water comes from drainage basins in seven states. The San Francisco Peaks near Flagstaff have boreal forests of spruce and fir, but only after heavy rains do the waters in the streams which flow off the peaks reach the intermittent Little Colorado a few miles away. Pine-topped mountains in central Arizona rise above streams and canyon lakes that are famous as boating and fishing resorts, but the barren valleys and ranges along the southern border mark the Jornada del Diablo — the Devil's Highway — once lined with the bones of early travelers west who failed to reach the widely spaced watering places along this early trail to the Coast.

The key to much of this contrast is the variation in altitude within the state. The Colorado River floodplain is barely 100 feet above sea level at the Mexican border near Yuma, while the San Francisco Peaks reach the highest elevation in the state at 12,655 feet. Elevations vary widely over short distances, but three major topographic regions can be recognized. These are the region of desert plains and mountains in the southwest, a belt of high mountains and narrow valleys trending northwest through the center of the state, and the land of high plateaus and

mesas north of the mountains. These have been formally designated the desert, mountain, and plateau regions, respectively. Other classifications of the state have been made, each based on special features such as geology, climate, rock and soil types, and vegetation. They all, however, are related in some way to the basic topographic divisions.

The desert region is characterized by isolated mountain ranges, rising abruptly from low, broad valleys or plains. Most of the ranges are elongated in northwest or north directions, and they occupy less area than do the intervening valleys. The valley floors step up in elevation from near sea level in the southwest corner of Arizona to 2,000 feet or more near the mountain region. The desert ranges themselves are less than 2,000 feet high over most of the area, but peaks above 7,000 feet are found in the eastern part.

The desert region grades into the mountain region, which differs from it in having a greater density of mountains, with individual ranges at elevations as high as 8–10,000 feet. The average elevation of this province is above 5,000 feet, with the highest and most mountainous part in the central section of the state. The central mountain region is in the zone that receives the highest rainfall in the state, but the high ranges on the northwest and southeast ends of the mountain belt rise directly from arid or semi-arid valleys.

The plateau region is an area of flat-topped mesas and plateaus, lying at elevations above 5,000 feet, incised by deep canyons and surmounted locally by volcanic peaks such as the San Francisco Mountains. The plateau is separated abruptly from the mountain



— Arizona Highways

Physiographic map of Arizona showing the basic topographical features

region along the Grand Wash Cliffs on the west and the Mogollon Rim through the center of the state.

The topographic configuration of Arizona is related directly to the geological structure and his-



— Chuck Abbott

Thomas Canyon in the southwestern basin and range country —Baboquivari peak to the east

tory. The plateau region belongs to the Colorado Plateaus Province, which extends north and east into Utah, Colorado, and New Mexico. The desert and mountain regions are part of the Basin and Range physiographic province which extends from southern Oregon and Idaho southward into Mexico and eastward into New Mexico and west Texas, and are frequently designated as the Sonoran Desert and Mexican Highland sections of the Province.

Recent work has shown that, geologically, the structural boundary between the Plateau and Basin and Range provinces is not along the Mogollon Rim, but is farther south, within the mountain region, and that the change from one structural province to the other takes place across a transitional zone. Other classifications, such as those based on climate and vegetation, may also cut across the basic topographic

divisions of desert, mountain, and plateau.

Because the state as a whole slopes downward from east to west, Arizona lies within the drainage system of the Colorado River. In the northern part of the state the principal tributaries of the Colorado are the Virgin and Little Colorado rivers, while in the central and southern parts the main tributaries are the Williams and Gila rivers. The Mogollon Rim and the White Mountains, located in east-central Arizona, are the primary watersheds for the northern and central parts of the state. Those streams rising on the north side of the Rim and the northeastern slopes of the White Mountains drain into the system of the Little Colorado river, while those whose headwaters are on the south side of the Rim and the southern and western slopes of the White Mountains empty into the system of the Gila and Salt rivers.



— Chuck Abbott

Monument Valley in the high plateau country of northeastern Arizona

In southern Arizona, the principal rivers — the Santa Cruz and San Pedro — run north, rising in the highlands of the Arizona-Mexico boundary area and draining into the Gila. These streams, like the majority of others in the state, are intermittent, dependent upon local precipitation or run-off from the mountain reaches for their streamflow.

In Territorial days many of these now-intermittent streams were narrower, shallower, and ran year-around. Several varieties of fish were found in abundance, and game birds lived in the tall marsh grasses along the banks. On the rolling uplands, grass taller than a man provided lush grazing. But a natural erosion cycle which began in the 1890's, and whose effects were heightened by overgrazing throughout the state at the same time, began cutting, deepening, and widening the river channels.

As in other states, early white settlements in Arizona were usually along the rivers where the availability of water, and flood plains suitable for cultivation provided opportunities for making a prosperous living. Only special factors, such as the existence of ores in commercial quantities, lured settlers far from the rivers. Today, man has learned to dominate his environment sufficiently so that he may settle more or less where he pleases. The development of large-scale irrigation projects, and of pumps capable of bringing water from great depths, the advances in cooling and heating of homes and industrial plants, together with modern communication and transportation systems — all have not only contributed to the increasing growth of Arizona's older cities but to the settlement and expansion of those communities far removed from the rivers.

..... *climate*

THE RANGE OF TEMPERATURES IN ARIZONA IS extreme. Average annual values vary from the middle seventies on the desert plains bordering the Gila and Colorado rivers to the middle forties in the pine country of the central part of the state. Summer temperatures above 120°F. have been reported at all towns along the lower Colorado River south of Hoover Dam and along the Gila River west of its confluence with the Salt River. The record high of 127°F. is held jointly by Parker and Fort Mohave, both on the Colorado. At the other extreme, several towns in the higher elevations have observed temperatures lower than 30° below zero.

Fort Valley, an experiment station northwest of Flagstaff, and Maverick, a lumber camp high in the White Mountains southeast of McNary, have recorded lows of 33° below zero. The state's warmest and coldest towns are, respectively, Mohawk (located about fifty miles east of Yuma) and Maverick. In July the average temperatures for these two locations differ by almost twenty-five degrees, the average at Mohawk being 94.3°F. and at Maverick 59.9°F. Thus, Arizona offers a wide range of thermal climates, varying from the long hot summers and short mild winters of the warm deserts, to the short cool summers and long icy winters of the cold highlands.

Arizona has three basic climates: desert, steppe, and highlands, which cover, respectively, about 30, 53, and 17 percent of the state. Climatologists use average annual precipitation and mean temperature of an area to determine into which of these classifications each area should be placed. A simplified map of these three areas (Fig. 1) shows each subdivided into warm and cold, depending on whether the

average temperature of the coldest month is above or below 32°F. Temperature and precipitation records from 176 weather stations were used in constructing the map. However, most of these are located in the central and southeast parts of the state, leaving large areas where the climatic classification is determined primarily on hypothetical correlations between climate and vegetation.

The deserts and steppes are characterized by a lack of precipitation; the former more so than the latter. Practically all of the rain that falls in these regions evaporates; appreciable runoff and subsurface storage occur only during the wettest period. As a result, the vegetation cover is restricted, and consists mainly of creosote bush, cacti, and sagebrush on the deserts, and mesquite, piñon-juniper and various types of grass on the steppes. In these dry regions irrigation is a must for successful farming. The highlands on the other hand, normally receive sufficient precipitation during the year to support a moderately dense vegetation growth, with enough left over for substantial runoff onto the surrounding arid plains. This is particularly true of the cold highlands, which possess some of the finest and most extensive pine forests in the world, and where precipitation is reasonably dependable from year to year. In the warm highlands precipitation is less dependable, varying greatly in amount and intensity from one year to the next.

Annual precipitation in Arizona varies from about three inches on the warm deserts to more than thirty inches in the highlands. Most of this falls in the summer or winter, with only rare late or early storms occurring in the other seasons. The late spring



— Esther Henderson

An Arizona sky in summer — near Flagstaff

is especially dry. For example, Wellton, a small desert town located about thirty miles east of Yuma, has received measurable amounts of rain in May and June on only eleven days in the past thirty-seven years, an average of one rainy day every three or four years in these months.

Precipitation is heaviest and most dependable in summer, particularly in the highland regions of the state, which rarely experience a dry afternoon between the second week of July and the first week in September. Occasional cloudbursts may send torrents of water streaming down onto the surrounding valley floors, filling the washes and gullies to overflowing and doing considerable damage to roads and poorly located homes. Once in a while these storms may hit the desert towns, where they can be especially destructive. The inadequate sewer systems in most of these communities have not been built to handle more than moderate amounts of runoff.

Summer thunderstorms in the southern half of the state are frequently accompanied by hail, which, since 1950, has been responsible for property and crop damages estimated at more than \$2,000,000.

In a violent storm that struck Phoenix early in the afternoon of September 18, 1950, losses due to hail alone amounted to about \$680,000.

Summer rains are associated primarily with very warm, moist, and unstable air which sweeps around the southern and western margins of a semi-stationary high pressure area over the Atlantic Ocean and advances into Arizona from the Gulf of Mexico. Widespread and frequently severe showers and thunderstorms develop in this air when it is forced to ascend over the numerous mountain ranges of the southern and eastern sections of the state. These storms are most intense over the mountains during the midafternoon when surface heating and the general convergence of air, associated with upslope mountain winds, are at a maximum. In the lowlands the heaviest summer rains usually occur in the late afternoon or early evening when the valley floors are considerably warmer than the surrounding cloud-covered mountains.

Not all of the warm-season rainfall is of the type described above. A small part is associated with tropical disturbances which develop off the west

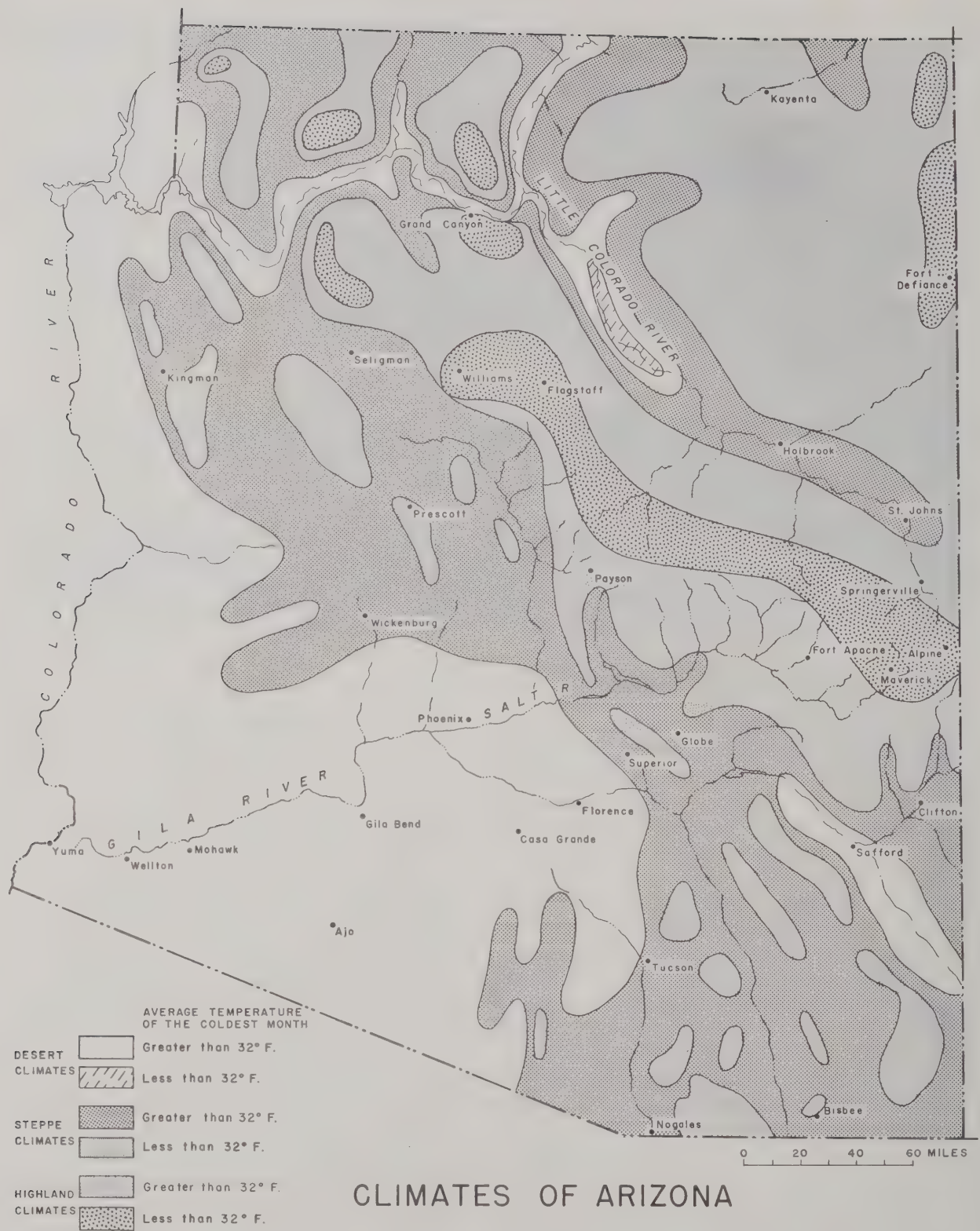


Fig. 1. Climates of Arizona based on modification of the Köppen classification

coast of Mexico at about 15° N. latitude. These storms usually dissipate as they move north, but they are occasionally intense and extensive enough when they reach the thirtieth parallel to produce heavy rainfall over most of Arizona. This type of storm differs from the more common summer type in that it is more widespread, has no tendency to occur at certain hours of the day, has a lesser intensity but longer duration, and is only rarely accompanied by thunder and lightning. Almost three-fourths of the towns in the state have received their heaviest twenty-four hour rainfall from storms believed to have been of tropical origin.

Winter precipitation is generally less intense but more widespread than that of summer. Part of this precipitation is associated with the storm belt of the middle latitudes, which occasionally advances far enough south for its margins to affect Arizona. It is only when these cyclonic storms move in directly from the Pacific Ocean across the northern and central parts of the country that measurable amounts of rain can occur. When the storm track moves in a north-to-south direction east of the 105th meridian, about all Arizona can expect is plenty of wind and subnormal temperatures, particularly in the north-east part of the state.

Probably the heaviest rains of winter are associated with the so-called "Kona" storms or "cold lows" of the subtropical Pacific Ocean. These very intense disturbances form in the vicinity of the Hawaiian Islands and move slowly eastward to the coast of southern California. In this region or slightly inland they often remain stationary for several days. But once they get caught in the strong upper-level easterly flow they move rapidly northeastward across the United States. These storms normally pass directly over Arizona, frequently advancing very slowly, and since they retain most of their moisture supply while moving in from the Pacific, they can produce several days of moderate to heavy rain and snow, often accompanied by lightning and thunder.

Rainfall is sporadic in all seasons of the year and practically always falls in very small amounts. For example, along the lower Gila River during the summers of the past ten years, 55.3 percent of the hourly precipitation totals were less than 0.05 inch, 76 percent were less than 0.11 inch, and 1.2 percent greater than 0.50 inch. These values are representative of much of Arizona.

Winter precipitation, dependent as it is on the location of the middle latitude storm track, is



— Esther Henderson

Summer storm in desert near Tucson

extremely variable from one year to the next. In some years, when the storm track is north of its normal position, drought conditions may prevail throughout Arizona from September through June, while in others, when the storm track moves south, the state may receive enough precipitation to veil temporarily its inherently arid condition.

The driest sections of Arizona in winter are generally the cold steppes, particularly those located north of the Little Colorado River. These areas are effectively sealed off from all the major sources of winter moisture by an enveloping curtain of high mountain ranges and plateaus, notably the White and San Francisco Mountains and the Mogollon Plateau to the south and southwest, the Wasatch

ARIZONA CLIMATIC DATA

Location	Daily Mean Temperatures (°F)				Annual Precipitation Total (Inches)	
	January		July		Rain	Snow
	Max.	Min.	Max.	Min.		
Ajo	63.9	40.8	103.0	77.0	9.10	T
Alpine	45.5	9.5	77.7	43.5	20.73	64.9
Bisbee	57.3	34.3	88.7	64.2	18.44	10.2
Casa Grande	66.2	33.5	106.9	75.3	8.20	0.1
Clifton	58.7	33.2	100.2	72.2	12.54	1.3
Flagstaff	41.0	14.2	80.6	50.5	20.27	69.4
Florence	66.2	36.3	105.6	74.2	9.84	0.2
Gila Bend	68.5	37.4	108.7	76.9	5.69	T
Globe	56.7	31.0	97.5	67.5	15.75	4.4
Grand Canyon	40.7	18.1	84.3	54.1	15.81	61.6
Holbrook	48.0	18.5	93.7	59.5	8.64	9.9
Kingman	55.8	30.9	97.6	66.8	10.63	3.9
Nogales	62.8	29.5	94.2	65.0	15.60	2.7
Payson	52.5	19.4	89.5	55.7	21.48	25.0
Phoenix	65.1	39.2	103.6	77.5	7.67	T
Prescott	50.4	19.9	89.1	56.2	19.32	29.7
Safford	60.2	28.4	99.2	68.3	8.95	1.3
St. Johns	48.2	16.1	90.1	56.0	11.59	21.6
Seligman	50.5	20.6	90.8	54.7	10.85	16.8
Springerville	47.7	14.5	82.2	51.4	12.11	26.3
Superior	61.4	45.2	96.6	75.0	17.49	1.6
Tucson	64.7	35.2	99.6	72.5	10.91	0.9
Wickenburg	63.6	29.9	102.4	69.1	10.99	0.1
Williams	44.5	16.8	84.2	51.5	21.88	67.2
Yuma	67.1	42.4	105.8	76.5	3.38	T

T — Trace, an amount too small to measure.

Mountains of Utah, and the Rocky Mountains to the northeast. These barriers, however, do not prevent the occurrence of unusually strong winds, particularly during the winter and spring. When a storm system passes over the area, winds with speeds in excess of thirty miles per hour may blow for several days, first warm from the south and then bitterly cold from the north.

All parts of Arizona have, at one time or another, received at least a trace of snow, but amounts are usually measurable only in the mountain sections of the state, where seasonal totals vary from one to five feet. The slopes of the higher mountains offer excellent opportunities for winter sports, even in the desert regions. Early season snowstorms are very unpredictable; therefore, it is a good policy for hunters and hikers to be prepared for the worst if they go into the mountains in the late fall months.

The mild dry winters of the southern Arizona desert have been a very important factor in the rapid population growth of the area. Temperatures in the coldest month usually range from the middle thirties in the early morning to the high sixties in the mid-afternoon. Below-freezing temperatures are rare, being restricted for the most part to the period near sunrise, and to low altitude areas which are strongly affected by the drainage of cold dense air off the surrounding terrain during the night.

Despite the high temperatures, many people find the summer climate of the Arizona desert less uncomfortable than that of the eastern parts of the country, primarily for two reasons: first, the extreme dryness of the air, with relative humidities often falling below 10 percent in May and June, helps to relieve the severity of the heat by increasing evapora-

tion; and second, virtually all homes and buildings are air-conditioned, either by refrigeration or by the less expensive evaporation coolers. During periods of low humidity even the cheapest evaporative coolers are quite effective. However, in some of the heavily irrigated sections high humidities, particularly during the summer rainy season in July and August, render evaporative coolers rather ineffective, and the trend is increasing toward the installation of refrigeration cooling.

The warm steppes of Arizona are slightly cooler, wetter, and more humid than the warm deserts throughout the year, however, the accent is still on heat and aridity. These regions have the prime advantage of being located close to the highlands, which offer refreshingly mild days and cool nights during the hot summer months. In winter, the warm steppes, particularly those in southern Arizona, are a popular center of recreational activity for visitors to the state. The temperature range between day and night in the cooler months is large, often exceeding forty degrees, with the early morning minimum lying in the upper twenties and the afternoon maximum in the low seventies.

Perhaps the most rugged climate in Arizona is found on the cold steppes, which are confined almost entirely to the northeastern corner of the state. Winters are cold, dry, and windy; the temperature normally falls below zero on four to six days between November and March. The summers are quite warm, especially in the northern part of the region, where afternoon temperatures above 90°F may be expected on fifty to sixty-five days during the warmer months. However, summer nights are cool; temperatures usually drop to the fifties by sunrise.

. *geology*

THE GEOLOGIC HISTORY OF ARIZONA IS PRESERVED in the records of rocks formed during five great eras of geologic time. These are, from oldest to youngest, the Older Precambrian, Younger Precambrian, Paleozoic, Mesozoic, and Cenozoic. Not all of the events that characterized these time divisions can be recognized at any one place, but the historical sequence can be pieced together by correlating rocks and structures from one area to another. The time scale by which geologic events are correlated is shown in Figure 1, as are the major rock units and geologic activity recognized in Arizona.

Divisions of the geologic time scale are not of uniform duration, but rather intervals characterized by major episodes in the history of the earth and the life on it. Radioactive age determinations of rocks from many parts of the world allow an approximate dating in years of events in the scale. The details of geologic history are not known with equal certainty for all parts of geologic time. Paleozoic and younger rocks contain fossils of plants and animal life which allow correlation of rock units over wide areas. Rocks of the Precambrian eras contain almost no fossil remains, and for this reason, and because these older rocks in many places have been eroded, deeply buried, or crushed in mountain building, the historical geology of Precambrian time is difficult to interpret.

OLDER PRECAMBRIAN ERA. The oldest known rocks of Arizona are exposed in the bottom of the Grand Canyon, and in the cores of mountain ranges in central, southern, and western Arizona. They consist of metamorphic and crystalline rocks such as

schist, gneiss, granite, and quartzite and, locally, of volcanic and sedimentary strata that have been little changed or altered.

Detailed studies of the Older Precambrian Vishnu, Yavapai, and Pinal schists of the Grand Canyon and of central and southern Arizona, show that these rocks originally consisted of thick sequences of sedimentary strata, largely mudstone and sandstone, with locally thick piles of basaltic lavas. The accumulation of as much as 20,000 or more feet of such rocks suggests deposition in a great sinking, elongated trough, or geosyncline. The orientation of this trough is not known, but the long axis possibly extended northeast through the state.

Minor disturbances affected the rocks locally during their accumulation, but there is no evidence of major mountain building until the end of Older Precambrian time when great earth forces, directed essentially from south and southeast to the north and northwest, crumpled the geosynclinal rocks and formed mountain ranges trending northeast. Great intrusions of granitic and similar rocks accompanied the mountain building, and locally metamorphosed the original sedimentary and volcanic rocks to schist, gneiss, and amphibolite.

This event, called the Mazatzal Revolution, was of such major importance that the structural pattern formed then has controlled almost all of the later geologic history of the state. Three major directions dominated this structural pattern. Folds, reverse faults, and schistosity of the rocks themselves trended mainly northeastward, along the axes of the mountain ranges. Other major structural lineaments, chiefly faults, along which large movements occurred,

GEOLOGIC TIME SCALE















ERAS	PERIODS and EPOCHS		Years x 10 ⁶	PLATEAU and TRANSITION ZONE	BASIN and RANGE PROVINCE	MAJOR EVENTS IN GEOLOGIC HISTORY	
CENOZOIC	QUAT.	Recent	1	Alluvium	Alluvium	Volcanism and minor faulting	
		Pleistocene		Pediment gravels	Pediment gravels		
	Tertiary	U		Bidahochi fm. ? Hickey fm Chuska ss. ?	Alluvial basin deposits Pantano fm. and related beds	Basin and Range orogeny; Transition zone and Plateau uplift [Volcanism Granitic intrusions Laramide Revolution]	 
		M					
		L					
MESOZOIC	Cretaceous	U	70	Mesaverde ss. Mancos sh. Dakota ss.	Sonoita gp. <i>Amole arkose</i> ? Bisbee gp	Nevadan Revolution Volcanism granitic intrusions Mogollon Highlands in central Arizona	  
		L					
	Jurassic		Morrison fm. San Rafael gp. Navajo ss. Kayenta fm. Moenave fm. — ? — Wingate ss. Chinle fm. Shinarump fm. Moenkopi fm.	Sedimentary and volcanic rocks			
		Triassic					
			200				
PALAEOZOIC	Permian		200	Kaibab ls. Toroweap fm. Coconino ss. Hermit sh. Supai fm. — Naco fm.	Rainvalley fm. Concha ls. Scherrer fm. Epitaph dol. Colina ls. Earp fm. — Horquilla ls.	General uplift	    
	Pennsylvanian			Paradise fm. Escabrosa ls.	Uplift in central Arizona		
	Mississippian	Redwall ls.		Martin fm.		General uplift	  
	Devonian	Temple Butte ls.		El Paso ls.			
	Silurian						
	Ordovician						
	Cambrian			Muav ls. Bright Angel sh. Tapeats ss.	Abrigo fm. Bolsa qtz.		
PROTEROZOIC	YOUNGER		550	Grand Canyon series	Apache gp.	Grand Canyon disturbance; diabasic intrusions	
PROTEROZOIC	OLDER		2000+	Vishnu schist	Yavapai gp.	Mazatzal Revolution; granitic intrusions	
					Pinal schist		

Fig. 1. Rock units in Arizona — oldest on the bottom — and associated animal life

were oriented along north and northwest directions. A glance at the physiographic map of Arizona shows the importance of these directions in the modern topography and drainage patterns.

Following the Mazatzal Revolution, which must have produced mountain ranges of a size to rival the loftiest ones existing today, there was a long period of erosion, which beveled the ranges down to their very roots. Parts of the erosion surface or peneplain produced at this time are still preserved in the Grand Canyon and in central and southern Arizona, where they were buried beneath younger rocks. The surface is remarkably flat and uniform, having only a few feet of relief in tens of miles in most places where it can be traced.

YOUNGER PRECAMBRIAN ERA. The Grand Canyon Series in northern Arizona and the Apache Group of central and southern Arizona record the geologic events that followed the erosional truncation of the Older Precambrian rocks. A total of at least 12,000 feet of sandstone, shale, limestone, and basalt flows was deposited on the old erosion surface in the Grand Canyon area. No more than 1,500 feet of similar rocks south of the Mogollon Rim occupy a similar position in the geologic column, and correlation of rocks and events between the northern and southern areas is uncertain, except that the Apache Group and the Grand Canyon Series both belong to the Younger Precambrian era.

The type of trough in which these rocks were laid down is not known. They were probably deposited by marine water spilling over from the continental margins. Algal structures and a few poorly preserved objects that resemble imprints of jellyfish or other primitive creatures only serve to suggest the types of life existing in the ancient seas.

Younger Precambrian time closed in Arizona with the Grand Canyon Disturbance, a mountain-building event that produced fault-block mountains trending generally northwest. There was extensive intrusion by diabase, but no granitic intrusion or intense crumpling or metamorphism of the rocks. This was a mild event compared to the Mazatzal Revolution, and the effects seem to have been pronounced only in the Grand Canyon area itself. The absence of any major structural disturbance in other parts of the state is shown by the fact that in central and southeastern Arizona, the Apache Group rocks were only slightly, if at all, tilted before the overlying Paleozoic strata were deposited. Some general uplift, however, is suggested by the fact that Apache Group

rocks were locally beveled by erosion.

The erosion interval that followed the Grand Canyon Disturbance produced a surface that is not as remarkable for its flatness as the one above the Older Precambrian rocks, but which is, nevertheless, amazingly uniform over large areas. The block mountains of the Grand Canyon area were worn completely away, with only a few masses of resistant rocks projecting as much as several hundred feet above the surrounding plains. Erosion continued until the Cambrian seas advanced across the low surface, laying down beach sand and fossiliferous mud and lime that marked the advent of a new era in the history of Arizona and the first record of abundant life.

PALEOZOIC ERA. Arizona during Paleozoic time was a broad shelf-like area, over which seas spread from deeper basins that lay to the northwest and to the south, depositing a blanket of sedimentary rocks a few thousand feet thick in most places. Irregularities of the shelf existed in the form of local swells and basins that modified the thickness and types of sediments deposited during different parts of the era. In particular, a large land mass in northeastern Arizona, the Defiance Positive area, remained above sea level during most of the Paleozoic. If it was submerged from time to time, it was later uplifted enough for erosion to strip off the deposits, because no Paleozoic sediments are left on the area except for a thin cover of red beds of late Paleozoic (Permian) age. A narrow ridge extending southwest from the Defiance area limited deposition in central Arizona during parts of Paleozoic time. This ridge, which probably appeared as an island archipelago at times, has been called Mazatzal Land. A large land mass that possibly existed in southwestern Arizona is called Enseñada Land.

The exact pattern of land and sea that existed at any one time is difficult to interpret, as many parts of central, and almost all of western and southwestern, Arizona do not now contain any Paleozoic rocks. However, a Paleozoic section a few thousand feet thick in the Harquahala Mountains, and a Mesozoic or Cenozoic conglomerate containing boulders of Paleozoic rocks in the New Water Mountains, support the belief that deposits once extensive over most of the state have been removed by erosion in post-Paleozoic time.

Sedimentation was not continuous during this era, but was marked by repeated advances and withdrawals of seas. The Cambrian seas, for example,

appeared to have spread over the old erosion surface cut on Precambrian rocks from marine basins to the south and west, in a flood that slowly advanced eastward into New Mexico. A gentle uplift, with no appreciable tilting, resulted in erosion or non-deposition, or both, so that almost no record is left of the next two Paleozoic eras. Only a few exposures of Ordovician rocks are found in the extreme southeast portion of Arizona, and no Silurian rocks are known at all in the state.

Repeated flooding in Devonian, Mississippian, Pennsylvanian, and Permian times left several thousand feet of sandstone, shale, and limestone, presumably over most of the state (Fig. 2). Of particular interest is the blanket of Mississippian limestone, nearly a thousand feet thick, that forms the Redwall cliffs of the Grand Canyon and the Escabrosa cliffs of several ranges in southeastern Arizona. The Mississippian limestone thins and disappears in the northern Tonto area of central Arizona, giving evidence of uplift along the Mazatzal Land trend, probably following Redwall deposition.

During some parts of the Paleozoic, particularly in the Pennsylvanian and Permian, rocks formed as deltaic, floodplain, and sand dune deposits interfingered with marine sediments. Rocks of these types are particularly well-displayed in the red bed sequences near the top of Grand Canyon, along the Mogollon Rim, on the Defiance Plateau, and in Monument Valley. A blanket of ancient wind-blown sand accumulated over much of northern Arizona to form the Coconino and DeChelly sandstone of the areas mentioned. These formations show, beautifully preserved, the cross-bedding typical of sand dunes that can now be observed in desert areas.

A final invasion of the Permian seas produced the Kaibab limestone that forms the rim of Grand Canyon and much of the thick, dark limestone of southern mountain ranges. The end of Paleozoic time in Arizona was not marked by any major mountain building such as the Appalachian Revolution of the eastern United States. Instead, a general uplift, local folding, and gentle erosion preceded the deposition of Mesozoic rocks. No igneous intrusive or volcanic activity left a record during any part of the Paleozoic Era in Arizona.

Life in Arizona during the Paleozoic Era was typical of that in other parts of the world. Shells and remains of marine animals such as brachiopods, mollusks, corals, sponges, and trilobites, are common enough in some places to furnish information

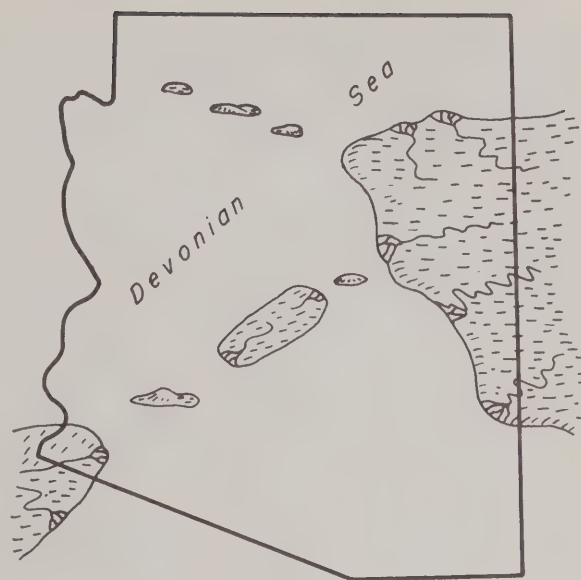


Fig. 2. Arizona in Devonian time

for dating the rocks. Teeth and plates of bony armor of primitive fishes give evidence of vertebrate life in Devonian and younger beds. Reptiles and amphibians had appeared by the end of Paleozoic time, but their fossil record in Arizona is scanty.

MESOZOIC ERA. Rocks representing all three periods of the Mesozoic were deposited in northern Arizona, but in southern Arizona the Cretaceous strata rest directly on eroded Paleozoic rocks in many places. Most deposits of the era are continental, but invading seas left marine sediments in the northern, northwestern, and southeastern parts of the state. Isolated outcrops of deformed and metamorphosed strata in southwestern Arizona might belong to some part of the Mesozoic; but fossil evidence is lacking.

Triassic and Jurassic rocks of northern Arizona are dominantly red beds, laid down along the margins of seas that existed to the north and northwest during most of the two periods. Streams flowing from highlands in central and southern Arizona deposited mud and sand that produced such spectacular formations as the Chinle, which contains the Painted Desert and Petrified Forest (Fig. 3). Great blankets of dune deposits such as the Navajo sandstone give evidence of arid, desert wastelands that occupied the area from time to time.

The shifting pattern of deposits attest to some crustal movements as well as changing climates in Triassic and Jurassic time. A sharp uplift in central Arizona produced the Mogollon Highlands in middle

Triassic time. This uplift followed approximately the trend of the present Mountain Highlands, and is recorded by the great sheet of Shinarump conglomerate that was spread northward as far as southern Utah. Lava flows and granite intrusion in southern Arizona can be dated as belonging to the Triassic and Jurassic, and the late Jurassic Nevadan revolution, which affected much of western North America, is believed to be responsible for the ore deposits of the Bisbee area. Also, gentle folding in northern Arizona is indicated by the fact that the Upper Cretaceous Dakota sandstone was deposited on an erosion surface that bevels Jurassic and older beds.

Lower Cretaceous seas did not reach northern Arizona but entered the southeastern corner of the state in the Bisbee area. Deposits of both continental and marine origin were laid down over much of southeastern Arizona during most of the Cretaceous, but the time and spatial relationships of these rocks are not well understood because of Cenozoic deformation and erosion. Upper Cretaceous seas invaded northeastern Arizona and left alternating deposits of shale, sandstone, and coal beds. For the most part, remnants of the old Mogollon Highlands limited these deposits along the present area of the Mogollon Rim, but one advance of the seas carried the shoreline in an embayment as far south as Clifton and the Deer Creek coal basin east of Winkelman.

Toward the end of Cretaceous time began the great period of crustal disturbance and granitic intrusion, known as the Laramide Revolution, which extended well into early Cenozoic time. In northern Arizona, the Laramide was marked by sharp to gentle folding, which produced great monoclines, faults, basins, and domal upwarps. Many of these structural features are elongated on north or northwest axes. Except for a regional uplift in middle Cenozoic time, the Plateau Province of Arizona appears to have been relatively stable since Laramide time.

In southern Arizona, intense folding, faulting, and igneous activity of the Laramide initiated crustal unrest that lasted into middle and late Cenozoic time. The great porphyry copper deposits of the state were produced during the Laramide interval.

Mesozoic life left a record in Arizona in the form of some of the best-known fossil localities of the world. Armored amphibians and crocodile-like reptiles from the Chinle red beds are exhibited in major museums in North America and Europe, and yearly expeditions are still made to collect from



Fig. 3. Arizona in Triassic time

the Chinle and other formations of northern Arizona. The Moenave formation near Cameron has produced skeletons of dinosaurs and of the most primitive crocodile known. The best specimens of early mammal-like reptiles of North America were found in the Kayenta formation north of Black Mesa.

CENOZOIC ERA. The Laramide Revolution continued into early Cenozoic time with mountain building and general continental uplift. In southern Arizona, the crustal unrest seems to blend with the middle and late Cenozoic structural activity that blocked out the present Basin and Range topography.

Successive generations of mountains were built by orogenies that involved strong folding, thrust faulting, batholithic intrusions, and widespread eruption of acid to intermediate lava flows. The last major thrust-faulting in the southern part of the state can be dated by fossiliferous beds as being later than middle Tertiary (lower Miocene).

The present mountain ranges formed after the compressional activity had ceased, and valleys be-

tween the ranges hold locally great thicknesses of late Cenozoic sediments. In some places these sediments are warped and faulted, but Pliocene and Pleistocene displacements of great magnitude seem to be restricted to the boundary zone between the Sonoran Desert and Mountain Highlands regions.

The Laramide faults, monoclines, and warps of the Plateau Province were beveled by early and middle Cenozoic erosion, and the area appears to have remained relatively stable during most of Cenozoic time, except for regional uplift. Arching of the Mountain Highlands in Middle to late Cenozoic brought the Plateau to its present elevation, resulting in a gentle northerly tilting of the Plateau strata. Breaking occurred along the margins of the province, chiefly following Laramide structural zones.

Erosion throughout most of Cenozoic time stripped soft beds from much of the Plateau, leaving large surfaces floored with horizontal or slightly-dipping resistant formations such as the Kaibab limestone on the Coconino and Kaibab Plateaus, and the Navajo sandstone on the Kaibito Plateau. Lines of south-facing cliffs were formed by the retreating softer beds, following down the general northerly dip. North-south cliffs were formed by erosion along faults, monoclines, and the margins of major upwarps. Ponding of drainage in Pliocene time formed extensive lake deposits in the Hopi Buttes area, before the final stages of erosion that carved the Grand Canyon (Fig. 4).

Cenozoic volcanic activity was localized in several fields of intrusive centers and flows on the Plateau proper and along the margins. Early stages are recorded in the eroded flows and volcanic necks of the Hopi Buttes, the laccolithic Carrizo Mountains, and older flows along the Mogollon Rim and in the White Mountains. Later activity produced volcanic piles in the San Francisco, Trumbull, and White Mountains. Volcanism continued into very late geologic time, with basalt flows pouring into the Grand Canyon after the latter had been cut to within a few hundred feet of its present depth. Eruptions in the San Francisco field have been dated by tree rings as occurring in the eleventh century, A. D.

Cenozoic life in Arizona is known from Miocene and younger fossil localities. Plants, fish, birds, fresh water mollusks, and mammals indicate that the climate was generally similar to that of today, but somewhat more humid. The abundance of fossils in some localities shows that herds of several types of extinct camels, horses, rhinoceroses, and antelopes roamed

the state at times, and were preyed upon by a variety of ancestral carnivores. In the late Pleistocene, more than ten thousand years ago, early man came to Arizona, where he found and hunted animals such as mammoths, ground sloths, tapirs, camels, bison, and horses.

Rock Units, Structure, and Physiography

PLATEAU PROVINCE. In Arizona the Plateau Province comprises several individually named plateaus together with valleys, buttes, and cliffy mesas; its general surface is surmounted in several localities by high volcanic mountains and deeply incised by canyons of the Colorado River system. Except for canyons and valleys, the region as a whole lies above 5,000, much of it exceeds 6,000, and some areas attain more than 9,000 feet in altitude. The southwestern margin or "Rim" of the Plateau is marked by ruggedly indented cliffs from a few hundred to more than 1,500 feet high. In some places, such as areas north of Clifton and southeast of Camp Verde, the cliffs are concealed by younger lava flows.

The Plateau Province is a land of spectacular landscape that almost everywhere reveals the geologic framework and history with graphic clarity. The Grand Canyon, one of the great scenic wonders of the world, is essentially a textbook of geology in itself. Here a mile-deep slice, carved by the Colorado River into the Plateau rocks, exposes a complex history of all types of geologic events spanning the five eras of geologic time.

In a broad sense, the Plateau is a great slab of Paleozoic and Mesozoic sedimentary rocks lying on a relatively smooth Precambrian basement, capped locally by thin layers of Cenozoic sedimentary and volcanic rocks. The sedimentary beds are nearly horizontal over large areas, but have been locally flexed by broad warps and sharp monoclinical folds, and broken by faults. A gentle northward tilt carries the Arizona section beneath younger rocks of the high plateaus of the northern extension of the province in Utah. Erosion during most of the Cenozoic has etched out the major structural features in a remarkable way. Many of the sedimentary rocks are persistent units across the Plateau, but some are lenticular on a broad scale, or show marked lithologic changes laterally, indicating the effects of local basins and swells in the sedimentational history.

A convenient subdivision of the Plateau includes the Grand Canyon Region, the Mogollon Slope, and the Navajo country. The Grand Canyon area

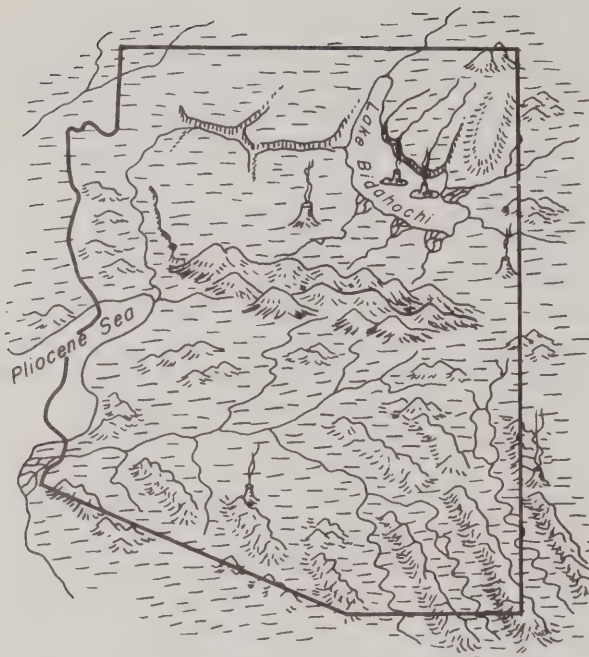


Fig. 4. Pliocene paleogeographic map

includes the individual plateaus north and south of the canyon itself and the Marble Platform on the east. The Mogollon slope is the up-tilted southern edge of the Plateau, northward from the Mogollon Rim to the valley of the Little Colorado River. The Navajo country comprises the mesas, plateaus, buttes, and valleys of the northeast corner of the state and coincides approximately with the Navajo and Hopi Indian reservations.

GRAND CANYON REGION. The Grand Canyon Region consists largely of a series of terrace-like plateaus, elongated north and south, separated from each other by faults and monoclines. The highest of these is the Kaibab Plateau, which is a structurally uplifted area, with both the topography and geologic section stepped down to east and west. To the west, the successively lower steps, north of the Colorado River, are the Kanab, Uinkaret, and Shivwits plateaus. The Shivwits is bounded on the west by the Grand Wash Cliffs, a great structural break that overlooks the Basin and Range Province. Most of the land south of the river is included in the Coconino Plateau, with the San Francisco volcanic uplift on the east and a series of down-dropped benches on the west. The surfaces of the Kaibab and Coconino plateaus descend to the east along the East Kaibab monocline to the Marble Platform.

The Colorado River flows westward across the

area, locally turning to follow boundaries between the major and minor structural blocks (Fig. 6). Tributary canyons are dissecting the plateaus both north and south of the river. The high plateaus and the Marble Platform are floored with Kaibab limestone, locally surmounted by remnants of Mesozoic sedimentary and Cenozoic volcanic rocks, but the extreme southwestern corner has been stripped down to the Mississippian and Devonian limestones. North of the river, the plateau surfaces dip under a sheet of Mesozoic rocks, which form impressive escarpments, for example, along the Vermillion Cliffs.

Cenozoic volcanic fields cover large areas of the plateau on both sides of the river. Locally the great sheets of basalt are surmounted by cinder cones and stratovolcanoes. The San Francisco Mountains near Flagstaff include the highest point in the state. Its lofty peaks held glaciers at least twice during the Pleistocene. Relationship of the lava fields shows that most of the lavas were poured out after erosional stripping of the Plateau down to the surface of the Kaibab limestone. Some flows pass unbroken across the major faults, showing that no renewed movement has occurred since the eruptions, but some flows have been broken by late Cenozoic faults.

MOGOLLON SLOPE. The Mogollon Slope is a convenient term for the area south of the Navajo country and north of the Plateau boundary. The Plateau strata dip gently north and northeast toward the Black Mesa basin. The western part of the Slope is underlain by Kaibab limestone, with patches of Mesozoic sedimentary rocks and Cenozoic lavas forming local prominences. The eastern edge contains a thick residual cover of Mesozoic rocks, including a few remnants of Cretaceous. Lake beds of the Bidahochi formation, and Cenozoic gravels along the edge of the rim cover the older rocks in places. The White Mountains volcanic pile covers the edge of the Plateau on the southeast, and late Cenozoic flows extend in tongues northward toward the valley of the Little Colorado River.

A spectacular feature of the Slope area is Meteor Crater. This mile-wide, bowl-shaped depression is believed to have been formed either by the impact of a prehistoric meteorite, or by a vapor explosion of volcanic source.

NAVAJO COUNTRY. The plateaus, butte, mesas, and canyons of the Navajo country are in many ways similar to those of the Grand Canyon Region, but consist mostly of younger rocks and reflect different structural controls. Two major features dominate

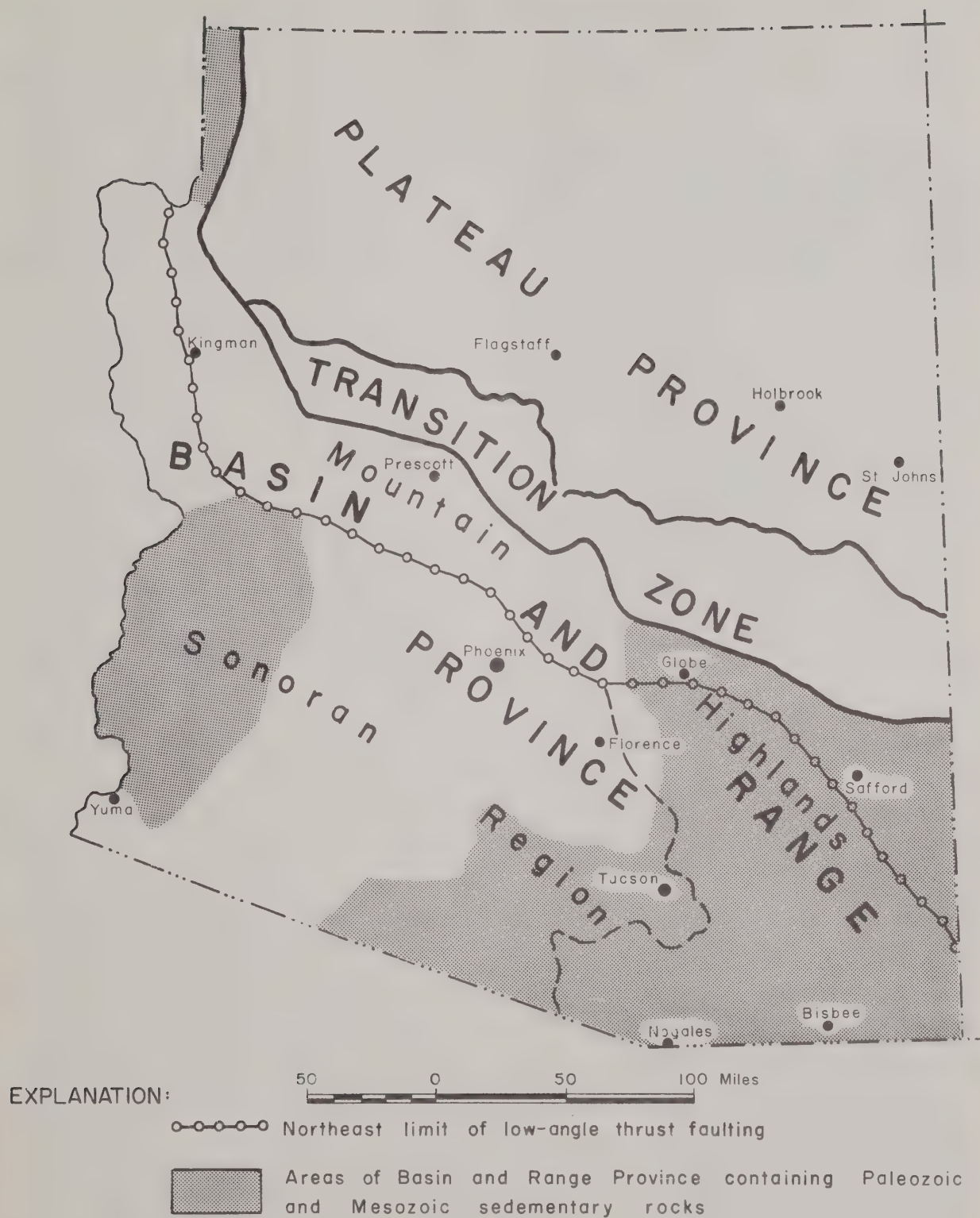


Fig. 5. Basic geologic provinces of Arizona today

the area, the great downwarp of Black Mesa Basin and the upwarped Defiance Plateau.

From west to east across the area, the stratigraphic section descends from the Marble Platform by the Echo Moncline, flattens across the Kaibito Plateau, dips under Black Mesa, emerges on the east, and, after another flattening in Chinle and Beautiful valleys, arches over the Defiance Plateau and dips under the San Juan Basin in New Mexico. The structural relief is greater than the topographic relief across the area, so the rocks exposed at the surface reflect the underlying structure. Black Mesa consists of a large circular patch of Cretaceous rocks surrounded by rings of older rocks.

The situation is complicated by minor structural features, and by the fact that certain stratigraphic units are lenticular or wedge-shaped. In particular, the entire Paleozoic beds rest directly on the Pre-Uplift, where Permian beds rest directly on the Precambrian basement. Cenozoic lake beds and lava flows, in the Hopi Buttes and southeast of the Defiance Plateau, rest on eroded surfaces cut on the older rocks.

The dominant land forms of the area are plateaus, mesas, and buttes, largely carved from brightly colored beds. Deep canyons fringe the mesas. Spectacular pinnacles, arches, and natural bridges eroded in the cross-bedded Paleozoic and Mesozoic sandstones form details of the landscape (Fig. 7). Canyon de Chelly cuts across the Defiance Uplift into the bright Permian red beds and rivals the Grand Canyon in scenic beauty, although not in size. Locally, particularly in the Hopi Buttes area, the landscape is dominated by volcanic necks which represent the congealed material solidified in the throats of Pliocene volcanoes now exposed by erosion.

TRANSITION ZONE. The Transition Zone (Fig. 5) has a somewhat arbitrary width of fifty miles in its southeastern segment, but narrows out in northwestern Arizona, near latitude $35^{\circ} 30'$. Topographically, it is more rugged than the Plateau, except for the area of the Grand Canyon. In general, the Transition Zone is lower in altitude than the Plateau, although some of its mountains rise as high as the "Rim."

The Transition Zone consists largely of Paleozoic and Precambrian rocks, overlain throughout extensive areas by Cenozoic lava flows.

Faulting since late Tertiary time has broken this zone in many places and separated it from the Plateau, which the zone resembles in that its strata

lie essentially flat, except for local minor folding. Headward erosion by tributaries of the Gila, Salt, and Williams rivers has carved this zone into deep canyons or valleys and steep-sided mountains. In accord with their lithology and structure these mountains generally are flat-topped or mesa-like in the areas of sedimentary and volcanic rocks which prevail over most of this region; sharp and rugged in metamorphic terranes; and rugged to rounded in crystalline rocks. Three great valleys of central Arizona in this zone, the Chino, the Verde, and the Tonto, were formed as the result of relative down-faulting plus subsequent erosion.

BASIN AND RANGE PROVINCE. The Arizona portion of the Basin and Range Province is characterized by numerous individual linear mountain ranges, which rise abruptly from broad plain-like valleys or basins.

These mountain masses attain altitudes of a few hundred feet to more than 10,000 feet above sea level. They measure from a few miles to 100 miles in length and from less than a mile to more than twenty miles in breadth. The widest and highest of the mountain ranges occur within an irregular, north-westward-trending belt ten to 150 miles wide, which occupies the northeastern portion of the Province (Fig. 5); it is termed the Mountain Region and provisionally referred to as the Mountain Highlands. Its highest peak, Mt. Graham, is 10,713 feet above sea level or 7,790 feet above Safford, in the adjacent Gila Valley. Mt. Lemmon in the Santa Catalinas, Mt. Wrightson in the Santa Ritas, and Miller Peak in the Huachuclas rise to more than 9,000 feet, but most of its other peaks do not exceed 8,000 feet in altitude.

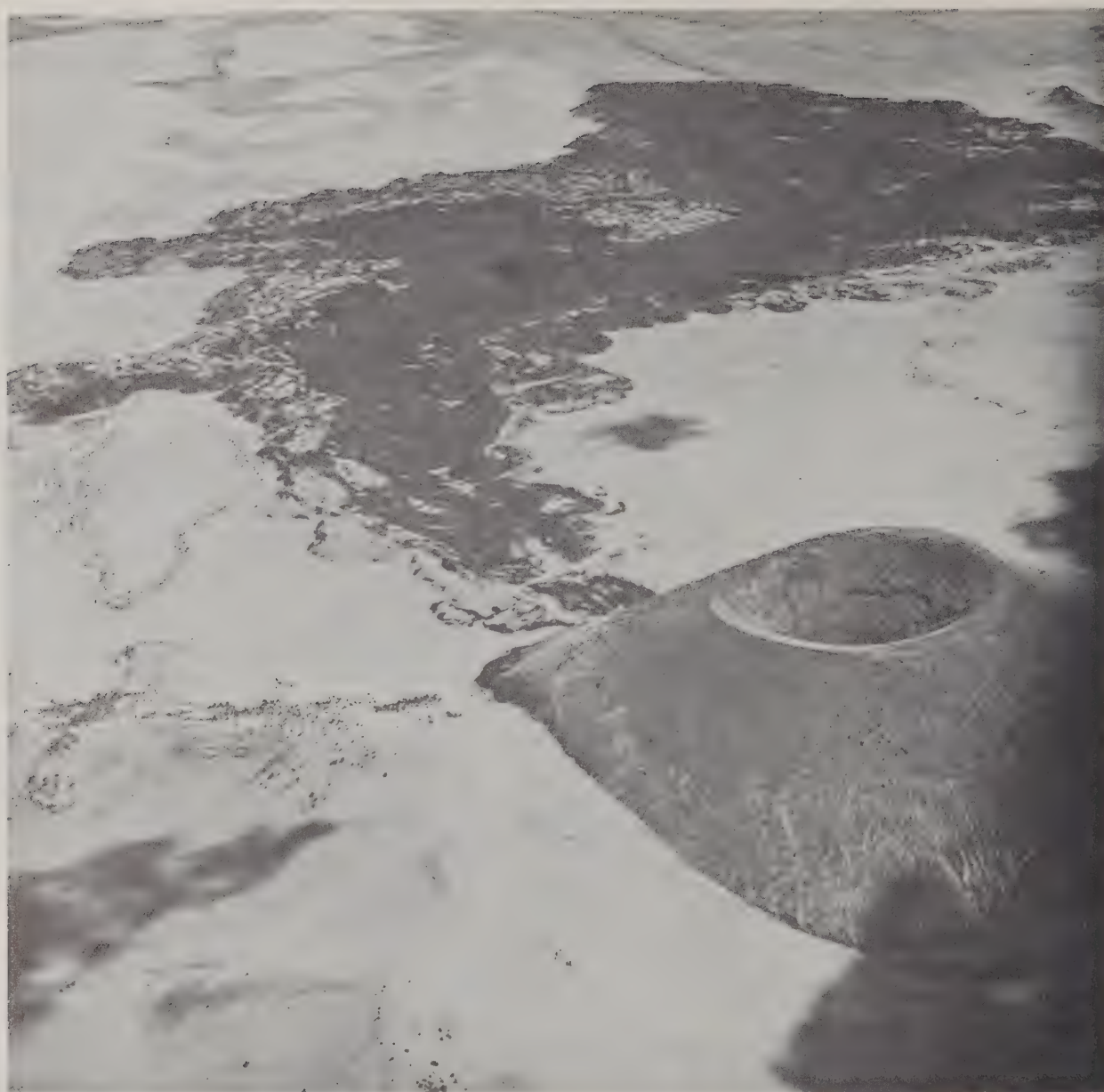
The portion of the Basin and Range Province that lies southwest of the Mountain Highlands is within the Sonoran Desert and may be referred to as the Sonoran Region (Fig. 5). Compared with the Mountain Highlands, its mountains characteristically are relatively low, rugged, and serrated (Fig. 8).

Only within particular areas are the mountain ranges approximately parallel to one another. For the Mountain Highlands, they follow somewhat the trend of the southwestern margin of the Plateau Province, except for a southward swing in southeastern Arizona. In the Sonoran Region, the mountains show sharp contrasts in alignment for various areas, and arcuate patterns predominate for them throughout an area of transverse ranges extending from Topock and Parker to Phoenix and Gila Bend.



— Ray Manley

Fig. 6. The Colorado River — showing its course between structural blocks



— Tad Nichols

Looking north across S.P. Crater and the San Francisco volcanic field

Most of the intermontane valleys of the Basin and Range Province in Arizona are dissected by drainage systems tributary to the Colorado River, and only a few closed basins, bolsons, or playas ("dry lakes") are present. In many sections the valleys are wider than the mountains, and some are more more than thirty miles across. The valley floors rise from approximately 100 feet near Yuma to 5,000 feet above sea level in the Sulphur Spring Valley of southeastern Arizona; many of them show

maxima of 1,200 to 2,000 feet of relief between axis and margin.

General Chronology of Rock Units and Structural Events

The geologic structure and origin of the Basin and Range Province as a whole are complex and difficult to unravel. Throughout large areas, the ages of its rocks have not been established positively, which makes geologic analysis provisional or doubt-

ful. Owing to alluvial cover on the intermontane plains, numerous features of critical importance may not be traced or projected with certainty from one mountain range to another.

Although many data have been gathered and theories evolved during the past 100 years, much additional research will be needed before this portion of Arizona can be thoroughly understood, or before its vast resources of minerals and groundwater may be adequately appraised.

Rocks of various ages from Older Precambrian to Recent make up the Basin and Range Province. Folding, faulting, igneous invasion, and volcanic eruption have afflicted the region at several intervals. As a rule, the structural deformation and igneous activity were governed by Older Precambrian features and therefore were most intense within particular areas or belts.

The general chronology, from oldest to youngest, is outlined in Figure 1.

The relationship of these periods of deformation and igneous activity to mineral deposits is discussed elsewhere in this volume.

Faulting and volcanism in Arizona are believed to be in a quiescent stage at present. No destructive earthquakes have occurred here during the present century.

ORIGIN OF THE BASINS AND RANGES. The present mountains represent blocks of the earth's crust, elevated by folding and faulting in reference to intervening relatively depressed blocks that underlie the basins or valleys. Displacement on the mountain-making faults of late Tertiary-Quaternary age may range from a few feet to 16,000 feet or more. This upheaval occurred intermittently from late Tertiary into Quaternary time, after a long history of folding, faulting, and igneous intrusion. Hence the internal structure of the mountain ranges is complex in many places.

Between the mountain ranges, the basin or valley troughs for the most part are filled with loosely to firmly consolidated gravel, sand, and silt, from a few hundred to thousands of feet deep, of Tertiary and Quaternary ages. Part of this valley-fill material was derived from neighboring mountains, and part was transported by streams from distant areas. Erosion has fashioned the topography partly in keeping with the types and structure of the rock masses and partly under climatic influence. In this semiarid climate, erosion operates dominantly through mechanical disintegration rather than chemical decay. The



— Chuck Abbott

Fig. 7. Spider Rock in Canyon de Chelly



— Esther Henderson

The Altar Valley and Baboquivari Peak — Basin and Range country

breaking-down process begins with differential expansion and contraction of the rock surfaces during repeated extreme changes in temperature. It acts most rapidly within zones of structural weakness. Meanwhile, torrential rains rapidly sweep the loosened rock fragments down slopes and outward onto the valley plains. As the stream channels become clogged through overloading, the floods spread sheet-like over the valley floors. Such sheet flooding is, through combined erosion and deposition, a primary factor in maintaining the plain-like surfaces of the valleys and mountain pediments. Winds are believed to cause only minor amounts of rock sculpture, but they transport much loose material, as proclaimed by extensive areas of dune sand in Yuma County.

MOUNTAIN HIGHLANDS REGION. The Mountain Highlands Region (Fig. 5) is made up largely of Older Precambrian metamorphic and granite rocks; Younger Precambrian quartzite, limestone

and shale; Paleozoic and Mesozoic limestone, sandstone, shale, and conglomerate; Mesozoic and Tertiary intrusive masses and volcanic rocks; Tertiary and Quaternary valley-fill deposits; and Quaternary lava flows. Its southeastern, northwestern, and northernmost segments differ markedly from one another in rock components and structure.

The Paleozoic and Mesozoic strata attain maximum total thicknesses of 6,000 and 10,000 feet, respectively, in southeasternmost Arizona, but they thin out northwestward and are absent throughout the 230-mile segment of the Mountain Highlands from Roosevelt Lake to Lake Mead. Northwestward, the Paleozoic beds thicken again, to a total of 9,000 feet in Arizona, north of Lake Mead.

Thick piles of volcanic rocks extend over large areas in the Chiricahua, Peloncillo, Mule Creek, Gila, Galiuro, Tumacácori, Superstition, Turret, Mohon, and Aquarius mountain ranges. They were formed by eruptions from numerous local fissures



Fig. 8. Tinajas Altas Mountains and basaltic lava outcrop in Sonoran Desert near Yuma

and vents during Mesozoic and Cenozoic time.

Structurally, the Mountain Highlands Region in Arizona may be regarded as an anticlinorium, a complexly folded arch in the earth's crust, upon which complex faulting has been super-imposed. Within this belt, Older Precambrian rocks lie at elevations thousands of feet higher than the Precambrian in the Plateau, and likewise higher than similar rocks in the neighboring Sonoran Region.

Overthrust faults, which dip at relatively low angles from horizontal, are common in the southern portion of the Region. Between Globe and Lake Mead, however, faults of this type younger than Precambrian are not known to occur within the Mountain Highlands Region, although they are common in the adjoining Sonoran Region. The thrust movement in general was from southwest towards northeast.

The principal folding and part of the faulting occurred during the Laramide or late Cretaceous-

early Tertiary interval, and additional faulting has taken place since late Tertiary time.

SONORAN REGION. Of the rock units which make up the Sonoran Region, some may be correlated definitely with those in the Mountain Highlands, and others are assigned to age groups upon uncertain bases of appearance or physical similarity. Metamorphic and granitic rocks of known or inferred Older Precambrian age occur widely distributed. Younger Precambrian strata are recognized in only a few small, isolated localities of southwestern Pinal County.

Sedimentary beds of Paleozoic and Mesozoic ages occupy widely scattered areas within the southeastern and western divisions of the Region. In the western division, the Paleozoic subcession is relatively thin, but the Mesozoic is very thick, and local features have been obscured by faulting, folding, or metamorphism. No Paleozoic or Mesozoic strata appear within a belt, sixty-five to 150 miles wide,

which lies between the southeastern and western divisions.

Granitic rocks, believed to be of Mesozoic age, constitute several mountain ranges in southern Yuma and southwestern Pima counties. Volcanic rocks of Mesozoic and Tertiary ages make up numerous mountain ranges, and sedimentary beds of those ages occur in many areas.

Loosely to firmly consolidated gravel, silt, and sand, of late Tertiary-early Quaternary age, from the intermontane valley plains which occupy from one-half to almost three-fourths of the Sonoran Region in Arizona. Marine limestone of late Tertiary age crops out in the lower Colorado River Valley north of latitude $33^{\circ} 10'$.

Basaltic lava flows of Quaternary aspect appear prominently in numerous localities. The Sentinel basalt plain, in southwestern Maricopa County, and the Pinacate, in southeastern Yuma County, are regarded as of historic or late pre-historic age.

Structurally, the Sonoran Region comprises numerous irregular fault blocks, among which relative uplift gave rise to the present mountains, and relative depression provided the intermontane valley troughs. This basin-and-range faulting of late Tertiary to Quaternary time was superimposed upon previous folding and locally complex faulting. Faults of the overthrust type are evident at many places and they are particularly common throughout the northeastern portion of the Sonoran Region.



..... *water*

ABUNDANT SUNSHINE AND THE SCARCITY OF water are two important factors in Arizona's economy. Because water is scarce, all possible information about it must be acquired and used effectively for the best interests of all. Man has made great strides in learning to live in the desert; however, his most urgent problem continues to be water.

Today, it is estimated that Arizonans use between six and seven million acre-feet of water each year. Paradoxically, in an average year, Arizona receives about eighty million acre-feet of water from rain and snow, of which only two million are captured. The balance for use is obtained from underground water reserves.

Sources of Water in Arizona

Arizona may be divided into three principal water provinces: (1) The Plateau Uplands including the northern part of the state, (2) the Central Highlands, a mountainous area extending diagonally across the state, and (3) the Basin and Range Lowlands, or desert, which includes the heavily-populated southern portion of Arizona (Fig. 1).

The Plateau Uplands are cool, semi-arid, and receive only small amounts of precipitation. The aridity of the Uplands is seen in the flat desert plains and most of the moisture from rainfall is dissipated by evapo-transpiration. Streams from the mountains fan out in broad, braided channels, where the water sinks into the soil and is soon pulled back to the atmosphere by evaporation. These intermittent streams yield very little water in proportion to the size of the drainage areas.

The Uplands include many mesas, buttes, and

several gentle-sloped mountains. The altitude ranges from 4,000 to 10,000 feet above sea level. Water supplies in this scenic wonderland depend on the availability of small amounts of surface water and the feasibility of drilling deep wells in sandstone aquifers. These water-bearing sandstones form a large natural underground storage reservoir, but not all the rocks yield water freely. Although the groundwater for the most part is undeveloped in the Uplands, full development may never occur because of the slow rates of movement and difficulty of extraction.

The rugged, mountainous Central Highlands province receives the heaviest precipitation within Arizona. As precipitation ranges from ten to thirty-five inches annually, surface water from rainfall and snowmelt occur in relatively large amounts. This is the area of perennial water supply and the source of streamflow to the lowlands provinces. The Highlands are composed of hard, dense rocks and some poorly-consolidated rocks. As the hard rocks have few voids they cannot store large amounts of water except where they are broken by faults and other fractures. Even though many springs issue along faults, there are not large amounts of groundwater stored in the mountainous area. The mountain slopes are steep with a thin soil mantle which affords rapid runoff and decreases the amount of water lost by evaporation.

A distinctive feature of grandeur and prominence in the Central Highlands is the Mogollon Rim. It extends more than 200 miles across the state and ranges in height from several hundred to more than 2000 feet. This brow forms the divide between the

Little Colorado and Gila River drainage systems. Many springs occurring near the base of the Mogollon escarpment feed perennial water into the upper tributaries of the Gila, Salt, and Verde rivers. Tonto Creek and Verde River join Salt River in a narrow gorge northeast of Phoenix, and here is where the storage reservoirs have been built for use by agriculture, industry, and municipalities in the hot arid desert.

The Basin and Range Lowlands, which contain more than 80 percent of the state's population, consist of isolated mountain blocks jutting from alluvial sediments that form the broad desert basins. The arid basins range in altitude from about 100 feet above sea level at Yuma, to about 4,000 feet in the southeastern part of the state. The climate in the lowlands is hot and arid and the rainfall is light, with precipitation averaging less than ten inches annually. Near the top of several of the high mountain blocks such as the Catalinas, annual precipitation may amount to thirty inches. However, there are large desert areas which receive less than five inches annually. There are no large surface water reservoirs in this province as the runoff is very small. Average runoff from the driest 15,000 square miles in the lowlands is less than 0.1 inch. The headwaters of the San Pedro, Santa Cruz, and other large tributaries yield only about 0.5 inch per year. San Simon Creek, which joins the Gila near Safford, has a runoff of only 0.1 inch. Bill Williams River at Alamo in the west central part of the state has a runoff of one-fourth inch. Streams draining several of the higher mountain ranges—the Huachucas, Pinaleños, Catalinas, etc.—yield moderate amounts of runoff along the base of the mountains. But when the water reaches the desert basin it evaporates quickly and only a small part recharges the groundwater reservoir.

Streamflow in the lowlands occurs mostly as flash floods following thunderstorms. Storms originating in the Gulf of Mexico extend into the southeast corner of the state and drop their moisture in the mountainous areas. As flood waters move downstream from the mountain areas, the volume of the flood decreases rapidly. Factors contributing to this depletion are infiltration, evaporation, channel storage, channel retention, and bank stream runoff. These natural losses of water are important factors in appraising stream runoff. As an example, a flood in the Santa Cruz River in August, 1954, showed a loss of 2,000 acre-feet between Nogales and Cortaro,

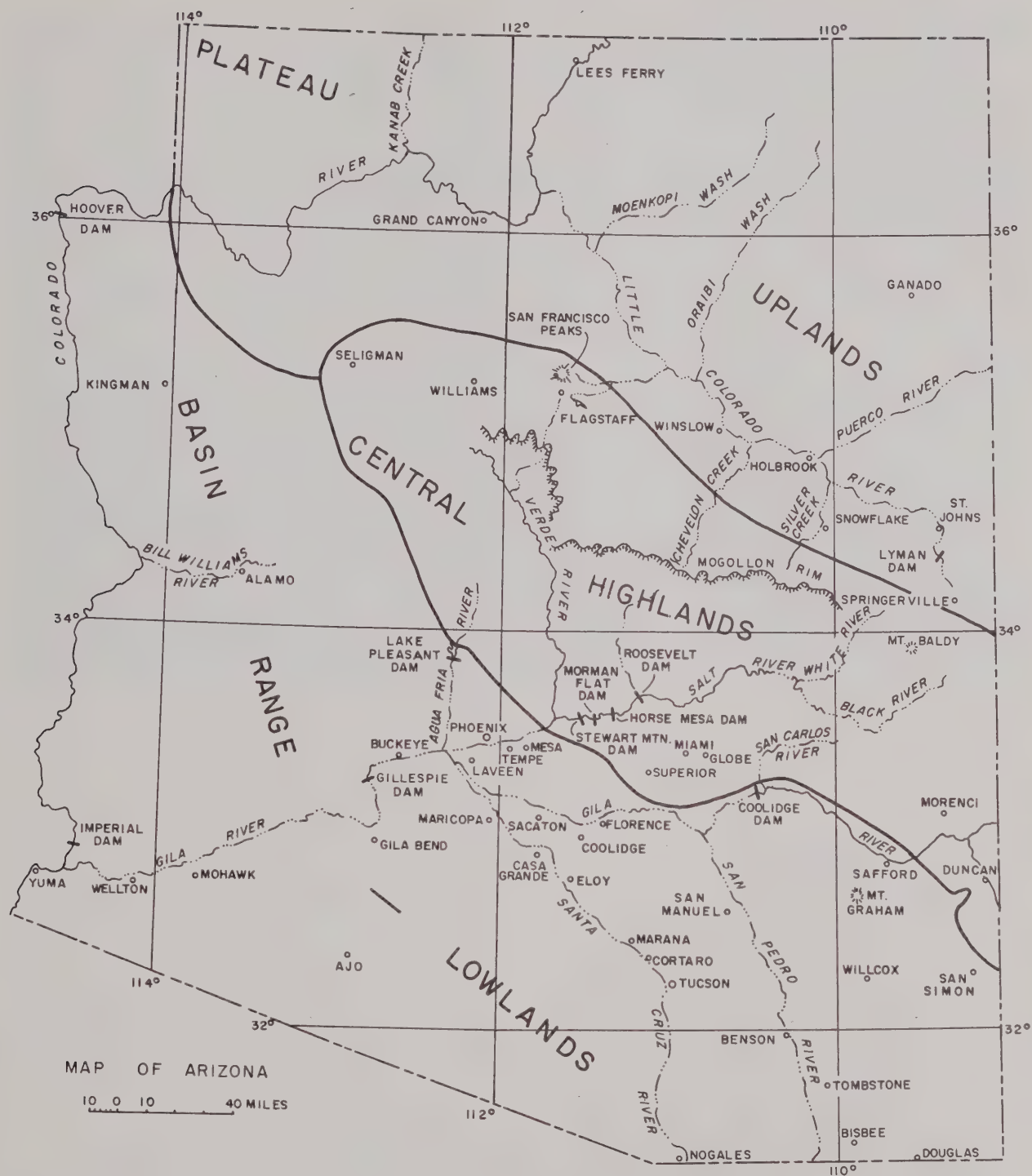


— Chuck Abbott

Sabino Creek — a typical desert stream

a distance of eighty-two miles, and none of this water reached the mouth of the Santa Cruz at Laveen. It is not known how much of this water seeps into the groundwater table and how much is lost by evaporation. Examination of water table fluctuations indicates only a small fraction reaches the groundwater reservoir. There is much merit in the belief that most of the water loss is returned as vapor into the atmosphere. However, much research is needed to answer these questions quantitatively.

The sediments in the alluvial desert basins constitute large storage areas for groundwater, and the occurrence of these large water reserves has made it possible for man to live prosperously and comfortably in the desert. However, continued withdrawal of these underground water reserves has seriously depleted them. In the lower Santa Cruz basin and in several areas near Phoenix, the water



WATER PROVINCES OF ARIZONA

Fig. 1 showing the three primary water provinces

level has dropped over 200 feet in the last twenty years. The amount of replenishment of natural recharge is a very small fraction of the amount withdrawn. Thus the pumping of groundwater at present rates is a depletion or mining process.

As the Central Highlands receive the largest amounts of precipitation, this province contributes the largest amount of surface water. However, runoff varies widely owing to differences in precipitation, temperature, and terrain. In the Mount Baldy area of the White Mountains, the average runoff is about four inches annually (one inch of runoff means a volume of water one inch deep over the entire watershed). The runoff in the upper Tonto Creek basin is more than two inches. The average runoff for the Salt River system above Roosevelt Lake is 2.8 inches or about 600,000 acre-feet per year. The streamflow in the Verde River basin in the western part of the Highlands is similar to the Salt River system. Oak and Granite creeks have an average runoff of four inches. The runoff at the Verde River where it enters the Salt River is 1.4 inches or 500,000 acre-feet. In the southern part of the Highlands province, San Francisco and San Carlos rivers and Eagle Creek are the main contributors of runoff to the Gila River. Their joint contribution into San Carlos Lake above Coolidge Dam is 0.6 inches annually, or about 210,000 acre-feet.

Most of the floods on the Central Highlands are caused by storms moving eastward from the Pacific Ocean, usually in winter or early spring. Large floods have occurred in the past, such as in February 1891, when the Salt River had a peak flow of 300,000 cubic feet per second (cfs). In November, 1905, the Verde River had a peak flow of 96,000 cfs. at its mouth. Other large floods have occurred in 1937, 1941, 1952, 1958, and 1960. In addition, storms originating in the Gulf of Mexico have caused large floods producing 31,000 cfs. in the Tonto Creek and 43,000 cfs. in Queen Creek. Sixty percent of the annual runoff in the Salt River drainage occurs between January and April, compared to 15 percent between July and September. The minimum flows occur in June and early July just before the summer rains commence.

Water from spring flow at the base of the Mogollon Rim provides perennial flow in headward tributaries. The estimated total discharge from about 150 springs totals more than 180 cfs.

Except for the main stem of the Colorado River, almost all the perennial streams that flow across the

Plateau Uplands originate in the Central Highlands. A ribbon of high precipitation extends along the Mogollon Rim westward to the Flagstaff area. Snowmelt and rainfall in this area drain northwest into the Little Colorado River system. However, owing to high rates of evaporation, the stream yields only small amounts of water. Also, small amounts of water seep into the subsurface as it drains northward over the highly fractured Kaibab limestone. Runoff from the Plateau is generally less than 0.3 inch except in the headwaters near the Rim. The principal streams are Clear Creek, Chevelon Fork, Show Low Creek, and Greer Creek, the west fork of the Little Colorado. The runoff in these headward streams ranges from two to four inches annually.

Silver Creek, which flows through the Snowflake area, has a runoff of three inches but about 6,000 acres are irrigated with the water and only 0.3 inch of runoff enters the Little Colorado. A similar situation exists on the upper Little Colorado near St. Johns where Lyman Dam impounds water for about 7,000 acres of land. The intermittent streams in the large expanse of arid lands to the north of the Little Colorado in the Navajo and Hopi Indian reservations yield only one-fourth inch of runoff annually. The low yield of streamflow in this province is exemplified by the Little Colorado River which is an intermittent stream although its drainage area is more than 26,000 square miles.

Many tributaries enter the Colorado River below Lees Ferry, the division point between the upper and lower basin states, but flow only during periods of heavy rainfall. However, several of these streams have a perennial flow from springs issuing from consolidated rocks. These include Blue Springs, Bright Angel Creek, Tapeats Creek (Thunder River), and several large springs in Havasu Creek near the west end of Grand Canyon Park. Their combined flow, plus that from other smaller springs, makes a total water contribution of about 300,000 acre feet per year to the Colorado River in the Uplands province. The average annual flow in the Colorado River at Lees Ferry is 13 million acre-feet annually, and the flow at the Grand Canyon station downstream is 12.5 million acre-feet. This flow includes part of the spring flow entering the Little Colorado and main stem of the Colorado.

OCCURRENCE AND GEOLOGICAL ENVIRONMENT. In the Central Highlands the alluvial sediment mantle, for the most part, is only a few tens of feet thick, whereas in the Basin and Range



— Chuck Abbott

Lake in the White Mountains — watershed for the Salt River system

lowlands, it is several hundred to thousands of feet thick. Water from the mountainous streams seeps through the sandy materials in the channels and moves downward by the force of gravity into the “lowland basins.” It forms the saturated zone overlying the impervious rock constituting the bottom of the basin. Over the past millenia, the groundwater has filled the large amount of pore space in the sediments. In fact, in places the basins were filled to overflowing and groundwater returned to the surface at the lower ends. Thus groundwater in the alluvial basins began as surface water and ended as surface water prior to entering the ocean. Such was the hydrologic balance prior to disturbance by man.

Water passing through pore spaces in sand and gravel moves very slowly and a long time is required for groundwater to reach its own level in an aquifer. Actually, groundwater never stands still and seldom develops a horizontal water table. The table, under natural conditions, slopes away from the source of supply and this slope is called the “hydraulic gradient.” Before White men arrived in Arizona, the

water system was in a dynamic hydrologic balance. Inflow equaled outflow. Outflow includes water leaving by evaporation, transpiration, streamflow, and groundwater underflow. Water used by man is obtained by diverting surface and groundwater from the system, and a large part of groundwater is drawn from the reserves in storage. Thus outflow may exceed inflow as is the case in Arizona where man is removing large amounts of water from storage and converting it into vapor which leaves the region via the atmosphere. Today the amount of water seeping into the water table from mountain streams and rainfall is many times less than the amount pumped by man.

AQUIFERS. Geologists define an aquifer as a water-bearing bed or stratum of earth, gravel, or porous stone. The distribution of these aquifers is of considerable economic importance. In the Basin and Range province, the water level in the upper part of the alluvial fill ranges from a few feet below the surface to several hundred feet. In places where the aquifer is overlain by nearly impervious silt and

clay beds, the groundwater is under artesian pressure, but commonly groundwater occurs in unconfined aquifers where water table conditions prevail. In general, the unconfined water table aquifers have a greater permeability than the artesian aquifers and are capable of yielding large amounts of water to wells. The artesian aquifers commonly occur at greater depths ranging from about 500 to 1,500 feet below the surface.

The main aquifers in the Plateau Uplands are fine-grained sandstone with alternating layers of non-water-bearing siltstone and claystone (Fig. 2). Over most of the area the deepest formation yielding water to wells is the Supai formation, and it consists of sandstone, siltstone, and mudstone. Only the sandstone is of water-bearing importance; however, the siltstone and mudstone are important in that they retard the downward movement of water and in many places the Supai formation is an important confining layer. The Coconino sandstone of Permian age lies above the Supai formation and underlies nearly all of the area. It is about 600 feet thick near Holbrook, but thins out northward. It is a fine-grained, well-sorted, highly crossbedded sand, deposited by wind action. The next aquifer of importance is the Navajo sandstone of Jurassic age. It too is an ancient sand dune deposit and is the principal water-bearing unit in the western part of the Navajo Reservation.

The Mesaverde group of rocks of Cretaceous age consist of a series of sandstone and siltstone units. The sandstone units yield small amounts of water in the Black Mesa area and constitute the sole supply for many schools and trading posts. Tertiary sediments and volcanic rocks in the Springerville-St. Johns area are important aquifers, but storage capacity is small. A number of wells yield groundwater from the shallow alluvium along the Little Colorado River drainage system. The alluvium is not favorable for large yields because of its fine-grained character, but ample supplies are pumped for stock and domestic use.

Although the Coconino sandstone is widespread areally, it is several thousand feet below the land surface in many places. Further, in places the chemical quality of the water is unfavorable due to high chloride content and makes it necessary to develop supplies from other sources. As the Navajo sandstone and Mesaverde rocks are limited in areal extent, it is not possible to develop water from these aquifers everywhere in the Uplands.

In general, the Plateau Upland aquifers yield only small quantities of water to wells because of their low permeabilities. Yields range from a few gallons per minute (gpm) to less than 200 gpm. However, where the sandstones have been faulted, fractured, and jointed, additional storage space and greater permeability are created and in such areas the yield is considerably more. Such conditions prevail near Flagstaff, St. Johns, and Snowflake. Wells in the Flagstaff area yield as much as 700 gpm. and near St. Johns a yield of 1800 gpm. has been reported.

The fractured character of the rocks is also favorable for recharge from rainfall and snowmelt as it affords avenues for downward percolation into the water table. Thus in areas of high precipitation, the rocks' character not only controls the groundwater supplies but also controls surface water in that the downward percolation reduces the amount of runoff of the area.

Uses of Water

The use of water may be separated into five categories: domestic and municipal, industrial and community, mining, livestock, and irrigation. Of these, the use for irrigation is, quantitatively, by far the most significant, since over 90 percent of the consumptive use of water in Arizona is for this purpose.

DOMESTIC AND MUNICIPAL. Requirements for domestic water, supplied by municipal and private water companies or privately owned wells, are the most vital. The total use for this purpose may be approximated by using the average daily per capita consumption in the Tucson and Phoenix communities.

In the city of Tucson and the urban area supplied by the city water system, daily per capita use has averaged 160 gallons per day over the period from 1955–1959. On this basis, an acre-foot of water is required to supply the needs of 5.6 persons for one year. It is believed that this figure may be applied to the approximately 250,000 population of the Tucson area.

The City of Phoenix Water Department reports a considerably higher use. In 1959 almost 195 gallons per capita per day were used by the 430,000 people in the service area. Smaller cities and towns, and users supplied by private wells are believed to have a per capita use less than that of Tucson. Assuming that this use is around 150 gallons per capita per day, the computed use in the state, based

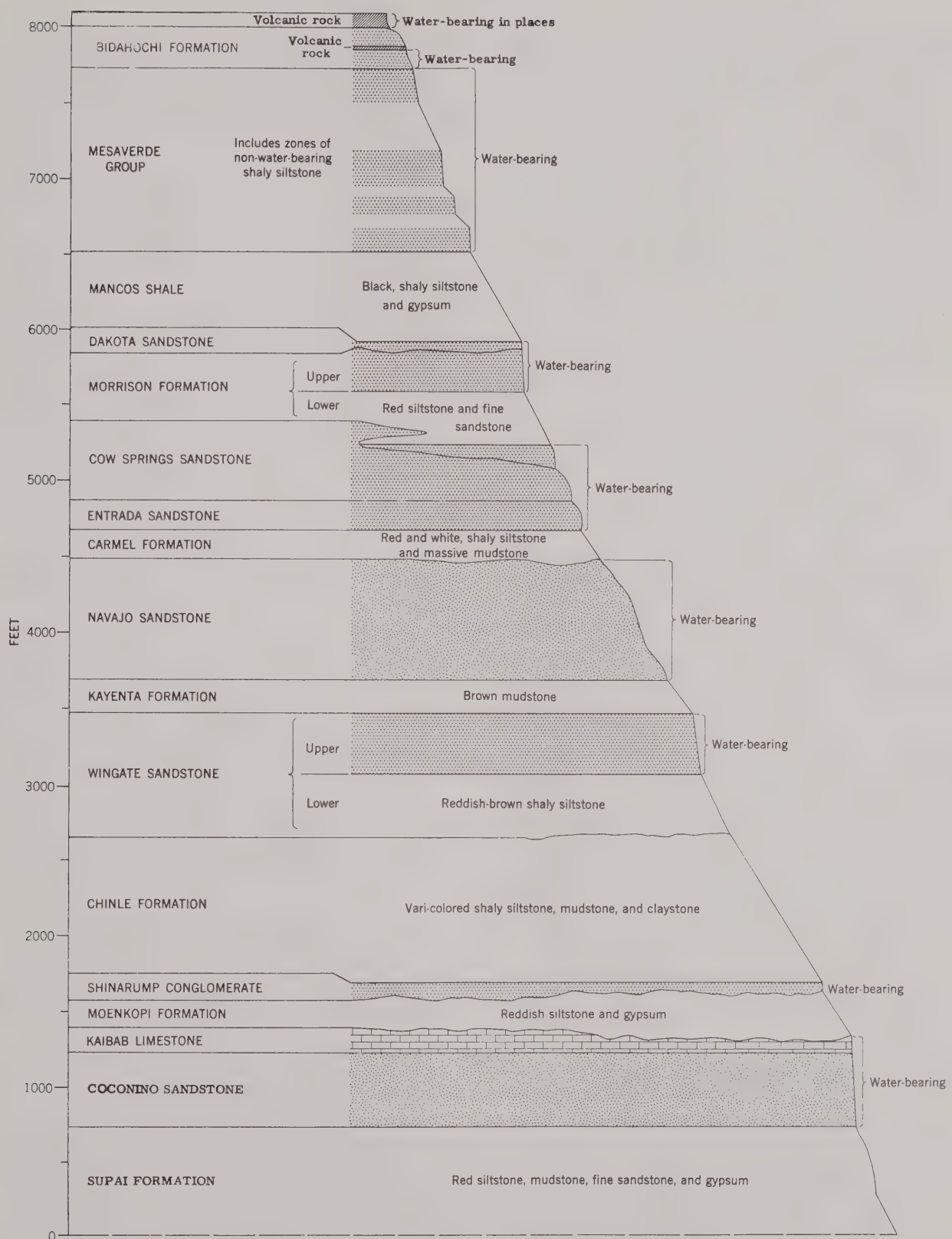


Fig. 2. Rock formations and water-bearing strata in northern Arizona

upon a population of 1,250,000, amounts to about 235,000 acre-feet per year. Included in this estimate is water used by small industries with limited water requirements.

INDUSTRIAL AND COMMUNITY. In all urban areas there are general community requirements. These include the water supply for golf courses, hospitals, school grounds, etc. Army and Air Force bases in the state in most cases have their own water supplies, but personnel and their families are largely supplied with domestic water by municipal or private water companies.

Industrial water requirements are chiefly for cooling purposes. Although not to be compared with those of heavy industry in the East, these requirements cannot be ignored. Industrial users include ice plants, railroads, gas compressor stations, sand and gravel plants, cement plants, laundries, airports, and steam plants for the generation of electric power. Steam plants require water for condenser purposes. Where water is cooled by evaporation, the amount used is almost in direct proportion to the power generated; however, the amount does vary with the quality of the supply and the efficiency of its use.

No accurate figures are available for the consumptive use of water included under industrial and community use, but a survey in the Tucson area indicated that it amounts to between 20 and 25 percent of the domestic water requirements. Assuming that the same ratio is applicable to the state as a whole, it is estimated the water requirements for these purposes are about 50,000 acre-feet per year. **MINING.** The major water requirement for mining in Arizona is for the milling and concentrating of low grade ores. Seemingly large quantities of water are required for this purpose with an average consumptive use of about 250 gallons per ton of ore treated. Total water use by the mining industry is approximately 50,000 acre-feet per year, which is equal to only about 1.5 percent of the consumptive use for irrigation. However, the gross value of products is approximately the same.

LIVESTOCK. Since earliest Territorial days, the livestock industry has occupied a most prominent place in Arizona's agricultural economy. Consumption of water by livestock in summer is estimated at about ten gallons per day per large animal unit, with an annual water requirement of about one acre-foot per year for each 100 head of cattle or horses. For the livestock population of approximately 1,125,000, the annual requirement is about 11,000 acre-feet.

Total requirements for the cattle industry are probably several times this, since much of the water is collected and stored for long periods in earth stock tanks from which evaporation losses may be as much as six feet in depth per year from the water surface area.

Estimates of the Soil Conservation Service place the number of these stock tanks at 12,000, with an average water surface of less than .75 acres each. The computed evaporation loss from stock tanks, with combined evaporation and plant transpiration of six feet per year, will result in an annual loss of about 54,000 acre-feet, so the total use by the stock industry should equal about 65,000 acre-feet per year. The aggregate amount collected in stock tanks will be considerably in excess of this amount, but the losses by seepage may be considered as a direct contribution to the groundwater supply and not a loss. **IRRIGATION.** Computations for determining the total amount of water used in Arizona each year for irrigation are intricate and complex. They involve the records of major water users such as the Salt River Valley Water Users' Association and others, and such records are often incomplete. Various other factors of evaporation, percolation, and transpiration affect such estimates. Calculations suggest, however, that the consumptive use of water for irrigation in Arizona each year is around 3.75 acre-feet per acre. The best information available indicates that the total irrigated areas in the state include 1,250,000 acres. Therefore, the net annual consumptive use for irrigation amounts to approximately 4,700,000 acre-feet of water each year.

Thus, the total consumptive use of water in Arizona may be summarized as follows:

Domestic and municipal	235,000 acre-feet
Industrial and community	50,000 acre-feet
Mining	50,000 acre-feet
Livestock	65,000 acre-feet
Irrigation	4,700,000 acre-feet
Total Consumptive Use	5,100,000 acre-feet

Water Use Regulation

Even in those areas of the world where water is plentiful it has been necessary to evolve a code of law concerning water use and ownership. In arid areas such as Arizona, water law is complex and varies in many respects from that of other states. Authority for control, distribution, and use is vested in the state land commissioner.

SURFACE WATER. Since earliest Territorial days, rights to surface waters have been acquired under the doctrine of appropriation. This doctrine, so different from the riparian rights theory of most states, holds that the first person to use the water from a stream to improve a parcel of land has the right to continue to use that same amount of water indefinitely, and no subsequent owner of lands bounding the stream from which the water is taken can claim an equal or better right. The rights of the prior appropriator are superior to the rights of any later settler either along the borders of the stream or anywhere else, and these rights are in no way dependent upon where the water is used, provided it is used beneficially and not wasted.

The Bill of Rights adopted by the First Territorial Legislature in 1864 declared that all streams, ponds, and lakes capable of being used for navigation or irrigation are public, and available for use in mining or irrigation by appropriation. Waters so appropriated are subject to previously vested rights acquired from the Mexican government or impliedly as the result of local customs. The inference is rather clear that percolating groundwaters were not subject to appropriation.

Since 1919, the appropriation and use of surface waters has been in accordance with the provisions of the Arizona Water Code enacted by the state legislature in that year. The present statute provides:

The water of all sources, flowing in streams, canyons, ravines, or other natural channels, or in definite underground channels, whether perennial or intermittent, flood, waste or surplus water, and of lakes, ponds and springs on the surface, belongs to the public, and is subject to appropriation and beneficial use, as herein provided...

The inclusion of waters in definite underground channels has led to much confusion. However, the Arizona Supreme Court has placed the burden of proof upon the person making application for a water right from a definite underground channel to show that such an underground channel exists. The criteria for establishing said proof are exacting, and to date only a few certificates of water right have been granted on this basis. One of these was presumably the result of a stipulated agreement between attorneys in a case before the Supreme Court. Prior to extensive development of ground waters by pumping, there were numerous instances in which diversions from surface flow became diversions from underflow from the same stream during the dry

seasons of the year. With general lowering of the ground water table this is now possible in but a limited number of locations, with underflow directly related to and a part of the surface flow of the same stream.

The 1919 Water Code vests in the state land commissioner the power to distribute water in accordance with respective priorities. Since most water rights, however, were acquired prior to the passage of the code, the major portion of the surface waters of the state are actually being distributed by court water commissioners appointed as the result of earlier court decisions, and not through the adjudication of water rights by the Commissioner under provisions of the 1919 Code.

GROUNDWATER. Water users in Arizona claim their water rights are vested property rights under the English common-law doctrine as asserted repeatedly by the courts of Arizona. Latest dicta of the courts indicate that consideration of the principle of reasonable use may become a factor in determining the extent of these rights, for landowners drawing water from a common source. The question of what constitutes reasonable beneficial use then becomes a matter of determination of the facts for each individual case. The American doctrine of reasonable use also differentiates between the rights of an overlying landowner placing water to beneficial use on this land, and the landowner transporting water to more distant lands either within or without the confines of the groundwater basin from which it is drawn. There has been no decision by the Arizona courts in this matter.

Groundwaters are not subject to appropriation in Arizona, and therefore prior rights to the use of groundwater cannot be acquired nor could they have been acquired under the doctrine of prior appropriation. It would appear that rights to the use of percolating groundwater in Arizona have been acquired in accordance with the English or common-law rules with no assurance or protection as to the permanence of a future water supply.

A measure of protection is provided by the Groundwater Act of 1948. This act prohibits the drilling of additional wells for the irrigation of new lands in areas designated as critical groundwater areas. It should be noted that this prohibition applies only to irrigation wells. Wells for certain exempted uses or purposes are excluded from the provisions of the act. An exempted well is defined as a well used for domestic, industrial, or for transportation uses.

The 1948 Act stated that it was enacted in the interest of general economy and welfare of the state and its citizens, to conserve and protect the water resources of the state from destruction, and to provide reasonable regulation for the designation and establishment of critical groundwater areas. The act also provided that any groundwater basin, or portion thereof, not having sufficient water to provide a reasonable safe supply for the irrigation of the cultivated land in the basin, should be designated as a critical groundwater area.

The act further provided for a system of permits for the construction and operation of all wells of over 100 gallons per minute capacity. Within critical groundwater areas, permits may not be issued for drilling new wells for the irrigation of lands not under irrigation at the time the area was declared critical, or within the previous five-year period. However, permits may be issued for deepening or replacing old wells. No new lands may be placed under irrigation within the critical areas. Permits shall be issued for drilling exempted wells for the withdrawal of groundwater for domestic, stock watering, water utility, industrial, and transportation uses. Wells may be constructed for any purpose outside of critical areas.

TYPES OF IRRIGATION ENTERPRISES. The ownership and operation of irrigation facilities, including dams, reservoirs, diversion structures, canals and distribution ditches, drainage structures, electric power and distribution lines, and pumping plants are found under various types of organizations. The more common types are: (1) private ownership, (2) corporate ownership, (3) corporate water companies, (4) mutual water companies, unincorporated, (5) mutual water companies, incorporated, (6) irrigation or other district forms, (7) water users' associations, and (8) federal projects.

1. Private ownership and control of water supplies predominate in Arizona where a major portion of the land is irrigated with pumped water from wells. Relatively few landowners have surface water rights with individual and separate diversions of gravity water. Pumping plants and other irrigation facilities are presumably on the tax rolls and subject to the same local and state taxes as other property.

2. Corporate ownership of land and irrigation facilities is also common, but is more prevalent in the large land holdings of several thousands of acres, with pumping from groundwater as the principal source of supply. A few enterprises of this type with

water rights of early priority continue to operate with their own diversion structures and canal systems. Most of these are located near the headwaters of a stream and are subject to the same taxes as are private owners.

3. Water companies are incorporated under state law, and, subject to the rules and regulations of the Arizona Corporation Commission were commonly formed as a subsidiary to a land development company. The primary purpose of the water company was to develop a water supply and construct a distribution system for the delivery of water to purchasers of land during the development and sales period. The usual sales agreement provided for the purchase of shares of stock in the water company equal in number to the number of acres of land purchased. Delivery of the water company stock was contingent upon the final payment for the land or, in some cases, payment of a certain stated percentage of the purchase price. Control and management of the water company thus remained with the land company for a long period of years, and the price for the delivery of water, usually on an acre-foot basis, provided a continual source of disagreement.

Most of these water companies have since changed their form of organization to that of district or mutual companies to avail themselves of the benefits accruing to these organizations, especially property tax exemption. The Cortaro Water Users' Association of Marana, Arizona, is one of the few remaining corporations of this type. Recently it made efforts to change to an irrigation district form of organization.

4. Mutual water companies, unincorporated, cooperative in nature, were one of the earliest forms of irrigation enterprise in the state. Some date back almost 100 years, and their water supplies from surface streams have highest priority. Only in recent years have these supplies been augmented by pumped water from wells owned either by individual farmers or water companies.

The mutual water companies are an association of private individuals for the purpose of providing an irrigation water supply, usually from a common source, on a non-profit basis for share holders. These companies are not subject to local or state taxes. Disadvantages are the difficulty of enforcing regulations and collecting assessments from members. Such companies are adapted only to situations where the irrigation problems are of simple character.

5. Mutual water companies, incorporated, are

similar in many respects to the unincorporated companies and have the same objectives. However, because of their corporate character mutual companies are better adapted to the operation of large and complicated forms of irrigation projects. Shares in the company are usually on the basis of one share for each acre of land. The business of the company is conducted by a board of directors, and individual land owners are not liable for debts of the company. Assessments may be levied against shareholders and their stock sold for non-payment of assessments. Tolls may be collected for delivery of water and if not paid, water may be withheld. Mutual water companies have the right to issue bonds the interest on which is tax exempt, and the property of the company is not subject to ordinary property taxes. They may mortgage the property of the company to insure payments of loans.

6. The irrigation district organized under state law has become the most popular form of irrigation organization. It is defined as a public or quasi-municipal corporation much the same as a city, with definite boundaries, but formed for a different purpose. It is a political subdivision of the state. The statutes provide for electrical, power, drainage, agricultural improvement, conservation, and flood control districts, which are similar in character to irrigation districts and differ but slightly from them in operation.

The irrigation district is created by the county board of supervisors after petition by the landholders, notification and public hearing, and a public election with the usual requirements for such elections. Electors must be land owners within the district boundaries and residents of the county in which the district is located. Each elector has but one vote irrespective of whether he owns much or little land. In this respects it differs from other forms of irrigation organizations. It is a self-governing, cooperative form of enterprise, operated and managed by the landholders through an elected board of directors subject to supervision by a board of state officials as specified by law with respect to the issuance and sale of bonds for the construction of irrigation facilities and for other purposes. The district as a public corporation is exempt from both state and federal income taxes.

Revenue for bond service and other purposes is obtained by assessments on an acreage basis, based upon an annual budget prepared by the board of directors and approved by the county board of super-



— Esther Henderson

Irrigated farm land in Maricopa County

visors. Upon order of the latter, the assessments or taxes are placed on the county tax rolls and are collected by the county treasurer in the same manner as state and other county taxes. Assessments become liens against the lands and the lands may be sold for non-payment the same as for other taxes. The county treasurer is ex-officio treasurer of the district. The budget must provide for operation and maintenance expense, interest, a sinking fund for bond redemption or repayment of money borrowed, deficiencies incurred in the previous year's operation, and may include a fund for the purchase at tax sale of the lands of delinquent landowners.

7. Water users' associations are a special form of corporate organization with some of the features of incorporated mutual water companies in that they

are exempt from the payment of local taxes, and shares are held and voted on an acreage basis. They are designed to meet specifically the requirements of the Reclamation Act of 1902 in providing a legal entity to represent a large number of water users with various size land-holdings, water rights of different priority, and water delivery from different canal systems and other facilities. The Salt River Valley Water Users' Association was the first of this form of corporate organization and has since been the pattern for many others in the West. It is stated that the basis and underlying reasons for the formation of the Association were these:

1. To establish, both for the benefit of the United States Government and the water users themselves, a central organization which could represent the individual water users in dealing with the Secretary of the Interior.
2. To establish and maintain a central organization which could be in position to guarantee payment of the construction costs of the Project to the government and to enforce collection of each installment of the construction costs from the individual landowners.
3. To establish a central organization which could assume at a future date the responsibility for operation and management of the irrigation works, and distribution of water to the landowners in accordance with their rights.
4. To insure that the right to waters stored by Roosevelt Dam would be equally available to all participants in the Association.
5. To insure that the cost of construction would be distributed equally among the members of the Association and that assessments should likewise be equitably distributed, notwithstanding use or non-use of water.

In 1937 the Salt River Agricultural Improvement and Power District was formed with identical boundaries and interests in order to secure for the Association lands the added exemptions and immunities granted to public corporations. All Association property was transferred to the District, but the Association continues to operate the irrigation system as agent of the District.

8. Federal participation in project construction has been largely through the Bureau of Reclamation under the Reclamation Act of 1902, supplemented by later acts of Congress. Contracts for repayment of construction costs must be executed by water users' associations before delivery of water, but the terms are most liberal. They may permit a ten-year

development period in which no payments are required and thereafter a fifty-year repayment term for repayment of construction cost without interest. Multiple purpose projects embracing power, navigation, fish and wild life preservation, flood control, and irrigation may now be included with reclamation. The construction costs payable by water users are limited to that part allocated to irrigation works.

During the period of operation by the Bureau, the water users' organization is responsible for the collection of all charges from the individual water users for operation and maintenance of the project works. The water users' organization is expected to take over the operation and management of project facilities when repayment of construction costs has been made on the major part of project lands. However, it may assume this responsibility at an earlier date through special arrangements with the Secretary of the Interior.

Federal funds have also been available through the Bureau of Indian Affairs for the construction, operation, and maintenance of project works and also for the subjugation of land for irrigation in Indian reservations. Hydroelectric or other types of power plants with transmission lines and substations have been included in some project works. Indian landowners or White farmers benefitting from the construction of Indian irrigation projects must repay construction costs under contracts similar to those in Bureau of Reclamation projects.

Development of Water Reserves

The principal areas of groundwater development are in the Basin and Range Lowlands. Large agricultural areas in the Salt River Valley and in the lower Santa Cruz basin are irrigated with groundwater. In about 1920 a startling situation developed in the Salt River Valley area. Surface water was used for irrigation and excess water caused the groundwater table to rise to the land surface, causing waterlogging of the land. Wells were drilled and pumped to drain the land and the water was transported for irrigation to the west of the waterlogged area. This was the beginning of the large well construction which led to the expansion of developing groundwater for irrigation that we find in Arizona today.

During the past ten years, about two and one-quarter million acre-feet per year in the Salt River Valley, and about one and one-quarter million acre-feet yearly in the lower Santa Cruz have been withdrawn. The annual withdrawal in these areas

constitutes about 70 percent of the total groundwater pumped in the entire state. Figure 3 shows the location of the basins where groundwater has been developed for irrigation, and the bar graph (Fig. 4) shows the totals of water pumped by years.

In 1957, there were about 3,500 active irrigation wells in the Salt River Valley and lower Santa Cruz basin, and the discharge from these ranged from 100 to 5,000 gallons per minute. Approximately 5,000 irrigation wells in the state deliver more than four million acre-feet per year. The depth of wells ranges from about 100 feet to over 2,000 feet deep. In recent years it has been necessary to deepen old wells or drill new deep wells in order to maintain large yields.

The entire water supplies for the Tucson metropolitan area come from groundwater reserves. Phoenix obtains its supply by pumping groundwater and also from surface water from the Verde River. Since the communities in the northern part of the state are small and have no large industrial water demands, only a few thousand acre-feet are withdrawn.

DECLINE OF WATER LEVELS. Groundwater table declines occur in areas where wells continually withdraw water from the subsurface reservoir in excess of local replenishment. The water table declines in the form of an inverted cone referred to as the cone of depression. When large quantities of water are pumped from closely spaced wells, the depression cones of such wells soon overlap and result in an irregular depression of the water table. As pumping continues in excess of recharge or replenishment, the depression continues in depth and extends outward with time, and eventually results in a depletion of the groundwater reserves. Many of the alluvial groundwater basins in southern Arizona are now in advanced stages of this depletion cycle.

The areas experiencing the greatest water level decline coincide with areas of large withdrawals. Records show that the water table has dropped over 200 feet in several places in the Salt River Valley in less than two decades. In Deer Valley north of Phoenix, the area of maximum decline has been as much as 100 feet since 1954. The water table decline in the Phoenix municipal area has not been so severe and is related to smaller withdrawals per unit area than in the agricultural areas.

The lower Santa Cruz basin in Pinal County has the second largest amount of water withdrawn in the state (Fig. 5). In the Maricopa-Stanfield area the total drop from the original static level, i.e., prior to

disturbance by man, is more than 200 feet. Again most of this drop has taken place since World War II. Recent field observations have revealed that a lowering of the land is taking place due to the large amounts of groundwater removal in the basin between Picacho and Casa Grande mountains.

In nearly all the groundwater basins the decline is related to the magnitude of agricultural development. There have been rapid declines in recent years in several areas where large scale vegetable cultivation has been carried on.

Safford Valley is one of the few fortunate agricultural areas that receives annual recharge or replenishment of water to the subsurface reservoir. Here the Gila River constitutes a source of water both for surface water diversion for crops and for recharge to the groundwater reservoir. Consequently, the water table fluctuates; the fluctuation is related to the annual amount of rainfall and runoff.

Within the water-starved Basin and Range lowlands, a unique situation exists in the Yuma-Wellton-Mohawk area. Here, surface water from the Colorado River is diverted for irrigation. As large amounts of water are needed to maintain good soil conditions, excess water has seeped into the subsurface. Within a period of several years, this downward seepage has caused the water table to rise to the surface and caused unfavorable conditions. Paradoxically, in the driest part of Arizona, water has become a nuisance and federal funds have been appropriated to construct drainage ways to transport excess irrigation water from the land.

GROUNDWATER RESERVES AND ULTIMATE WITHDRAWAL. The amount of groundwater stored in the desert alluvial basins of southern Arizona and the fine-grained consolidated rocks in northern Arizona is directly related to the porosity of the rocks. Porosity is not a measure of how much water can be removed. Rocks may have high porosities but yield very little water as the small pores hold onto the water tenaciously. In the alluvial basins the porosity ranges from a few to 40 percent, with the average about 25 percent. In the Plateau Uplands the sandstone aquifers have about 30 percent porosity.

The amount of water that can be withdrawn from aquifers is referred to as specific yield, which is the volume of water that can be drained from a unit volume of rock. It is expressed as a percentage to the total rock volume quantitatively. A certain amount of water is held in the rocks by molecular

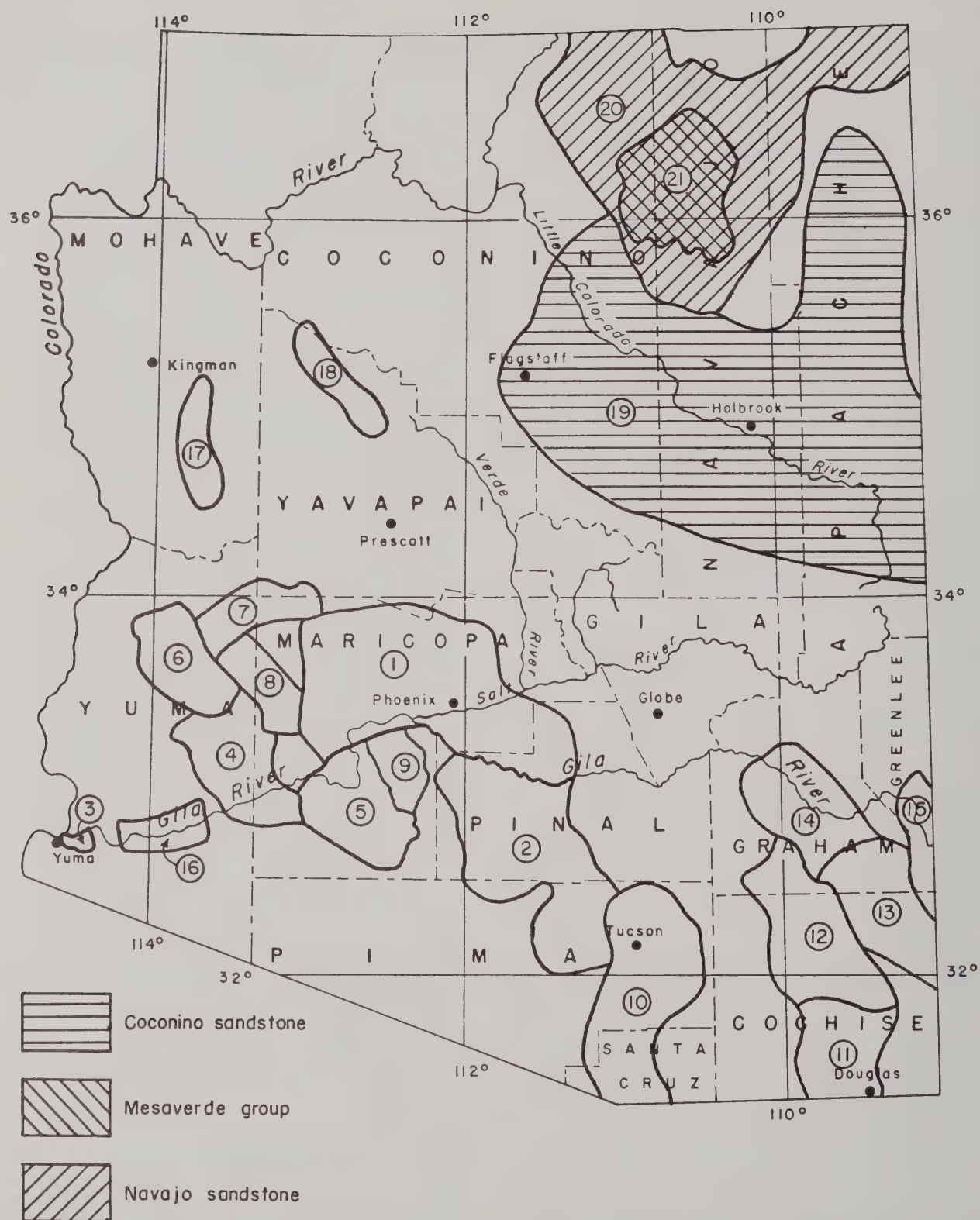


Fig. 3. Groundwater basins and aquifers in Arizona

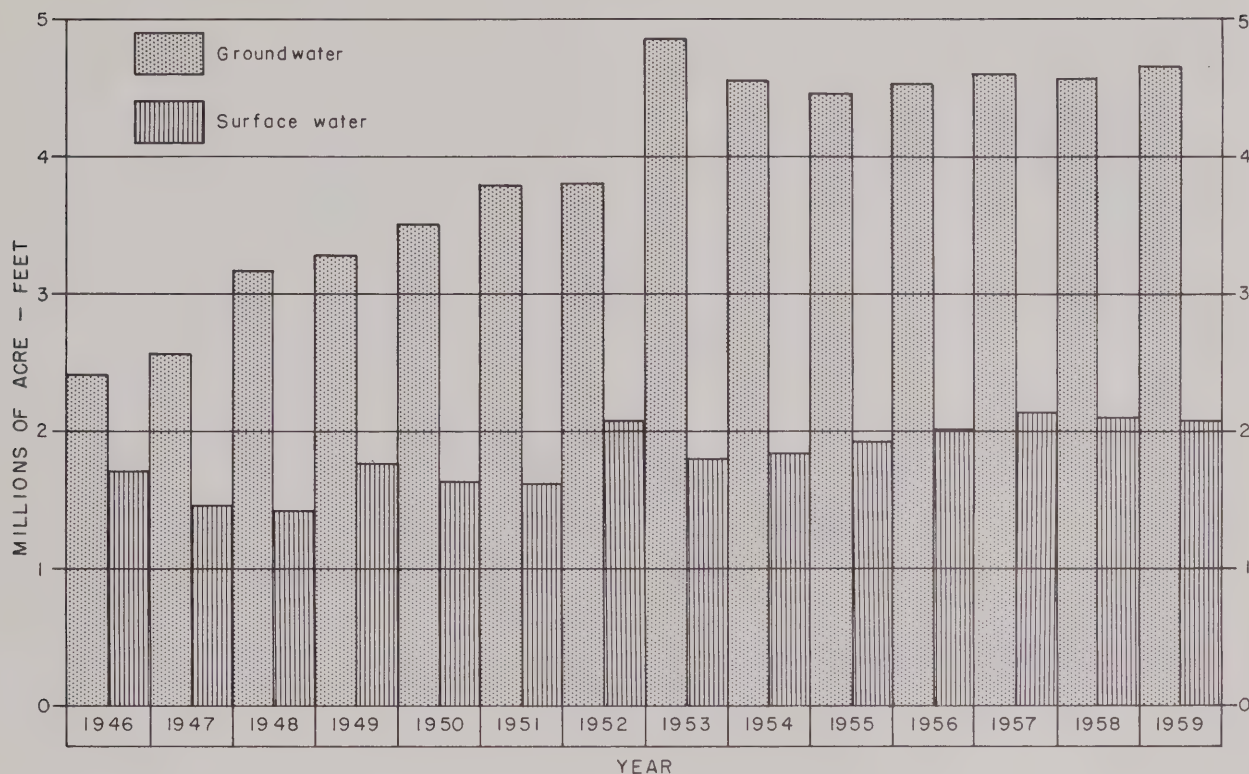


Fig. 4. Surface water diversion and groundwater pumpage in Arizona

attraction and adhesive forces. The specific yield of an aquifer is of prime importance in the production of groundwater, as the ultimate amount of water that can be withdrawn is related to this character-

istic. The alluvial basin aquifers have specific yields ranging from several percent to 30 percent. The sandstone aquifers in the Plateau Uplands have very low specific yields and tests indicate that, generally, the specific yield is less than one-half of 1 percent. **FUTURE TRENDS.** Large-scale water development in Arizona is one of the basic factors contributing towards the state's wealth today. The personal income of Arizonans has passed the two billion dollar mark, largely due to development of water. The federal taxes collected in one year amount to more than fifty times the original cost of Roosevelt Dam. However, of greater importance is the fact that the availability of water has stabilized a diverse and well-rounded arid-land economy in Arizona.

Population experts advise that Arizona will have about three million persons by 1980. Most of these people will be supported by an increase in industrial and mining activities. The increase in water demand for municipal and industrial use will be more than one million acre-feet by 1980. The additional population will create a demand on recreational activities, and the demand for water in places will be keenly competitive. Owing to a higher dollar return, water for recreational use may come from that used for

Figure 3 — Ground water basins and aquifers in Arizona

1. Salt River Valley
2. Lower Santa Cruz basin
3. South Gila Valley
4. Palomas Plain area
5. Gila Bend area
6. Ranegras Plain area
7. McMullen Valley
8. Harquahala Plains area
9. Waterman Wash area
10. Upper Santa Cruz basin
11. Douglas basin
12. Willcox basin
13. Bowie-San Simon area
14. Safford Valley
15. Duncan Valley
16. Wellton-Mohawk area
17. Big Sandy Valley
18. Chino Valley
19. Coconino sandstone
20. Navajo sandstone
21. Mesaverde group

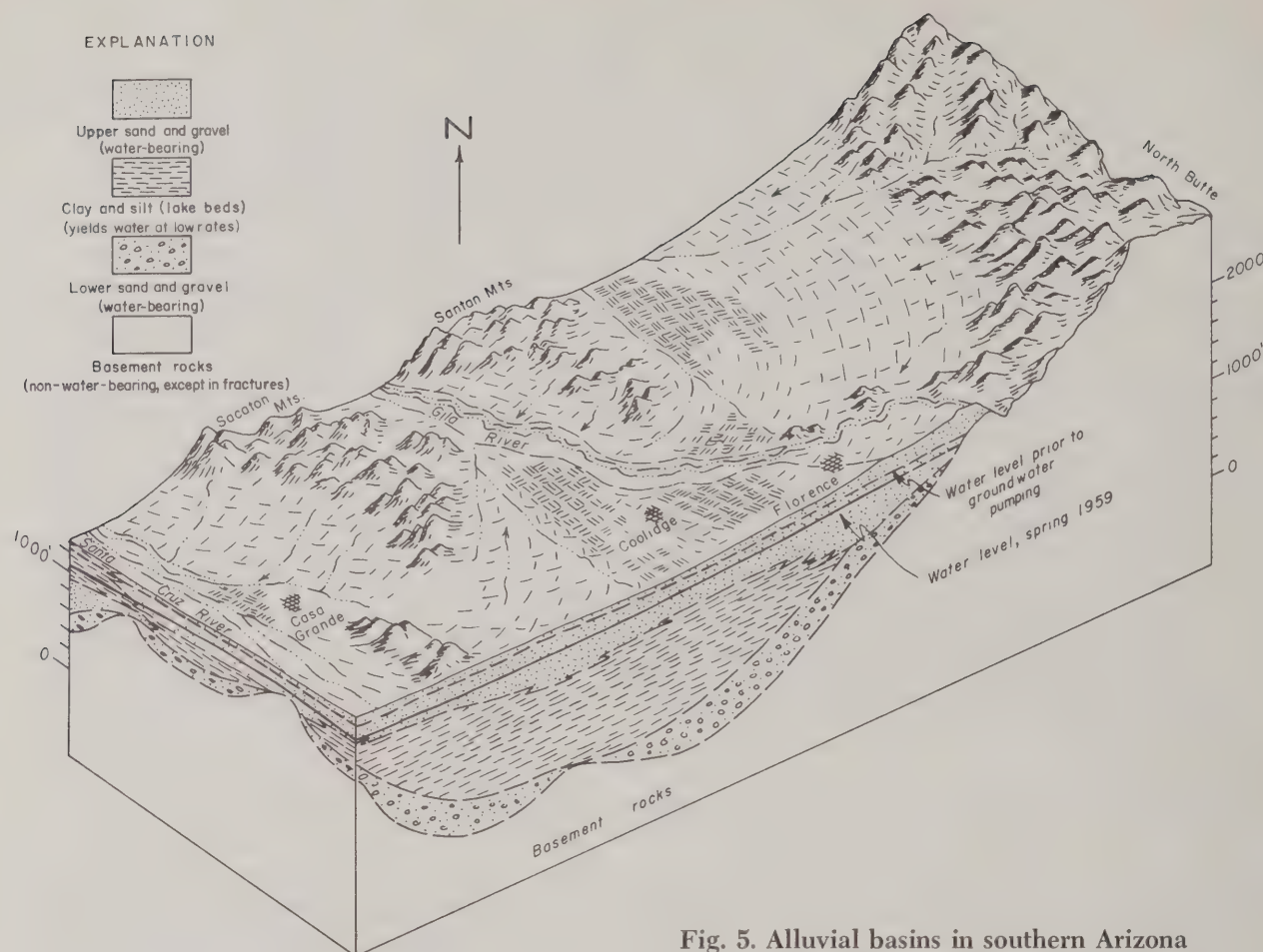


Fig. 5. Alluvial basins in southern Arizona

agriculture today.

Economics will continue to influence trends in water use. In the West, water for domestic use and livestock enjoys the highest priority. Agriculture ranks next, while industry and mining hold a poor third in position. An important trend taking place in Arizona is the transposition of industry and mining to the second position and agriculture to third. As the population is supported mostly by industry, the trend is natural, but a re-allocation of water supplies is not an easy matter, for legal codes, priority of rights, and availability of water all affect allocation. Further, all surface waters are already appropriated, mostly for agriculture, and the remaining source is from water reserves.

Agriculturists have recognized the shortage of water supply for maintaining continued irrigation. Research studies have paid handsomely, for today larger crop yields are being produced with the same amounts of water. The employment of conservation practices, particularly the lining of canals and ditches,

has also reduced the amount of water needed for crop growth. Cultivated acreage attained a near record high in 1959 without any increase in water use. Agricultural experts believe they will grow even greater crop yields in the future without an increase of water demand, and even hope to decrease the amount of water used today.

Many farmers believe they cannot pay more than twenty dollars for an acre-foot of water and make a reasonable profit. As industry and domestic water users can afford to pay a price several times this amount, economics in future water use are an important factor.

SOURCES OF WATER FOR FUTURE SUPPLIES. The vital need for additional water in Arizona is recognized by many leading citizens. Multiple-purpose planning for use of water and conservation is essential to assure adequate supplies for future years. Many suggestions and proposals have been made, but most do not realistically consider factors of the physical and economic conditions.

Several possible sources and methods of future water development include: (1) transport of water into areas of high demand and use, (2) development of groundwater at greater depths in alluvial basins, (3) capture of surface water for artificial recharge, (4) conversion of brackish water, (5) increased runoff from vegetation modification.

Water transport. The concept of transporting water into areas that have a high demand and use is not new. The basic factors are cost and allocation of water rights, permitting water transport. There are several sources of water in Arizona which are available for transport from an engineering and hydrologic viewpoint. However, the problems of obtaining necessary funds and the right to use the water owned by others must be resolved. The flow from springs at the base of the Mogollon Rim and other areas in the Central Highlands constitutes a possible source. Most of this water is lost to evaporation and transpiration on its route to the lowlands so that its contribution to surface water storage is quite small. Transporting such water to areas of high demand and use would provide man with more water for beneficial use.

Groundwater development. The depth of the alluvial deposits in the desert basins is unknown, but the occurrence of alluvium at 3,000 to 5,000 feet has been reported from oil well tests in several places. Complete saturation of alluvial materials would provide a tremendous volume of water but the chemical quality and quantities of water the sediments would yield have not been determined. However, detailed knowledge of the geologic fabric, and subsequent electronic computations may provide realistic estimates on the amount and rate at which groundwater could be withdrawn. The cost of pumping water is an important factor and thus the depth of the water level is paramount. Removal of water at rates that do not cause rapid decline is the keynote for successful exploitation.

In areas of intensive groundwater development and where local interests can pay the price, it is believed that additional groundwater can be produced by secondary recovery methods. The principles of reservoir mechanics have been used successfully by the petroleum industry in recent years. Secondary fracturing by hydraulic methods should be quite successful in fine-grained aquifers. Application of high pressure on artesian aquifers would maintain the water level close to the surface for economical pumping list. The limits of modern technology are

not known in the science of hydrogeology; indeed, much is still to be learned.

Artificial recharge. One the most practical measures to increase the availability of water supplies is the capturing of surface water and putting it in the subsurface. Artificial recharge methods have been practiced for nearly a hundred years in several parts of the world. In recent years much attention has been given to these methods in the Western states; and successful operations have been established in Texas, California, Oregon, Washington, and other states. In Arizona, several small experiments have been conducted successfully in the Salt River Valley area. Water stored in the subsurface suffers no loss by evaporation and can be recovered when needed. The capture of floodwaters in the lowlands and the transport of water to areas suffering from large water-table decline provide ideal conditons for successful operation. After the water is desilted and treated, it can be recharged into the dewatered sediments via wells. The specific retention or the wetting of rock material in dewatered areas is already satisfied and it is possible to recover nearly 100 percent of the water recharged. There are still many economic, legal, and engineering problems that need to be solved. However, as the need for additional water increases, there is little doubt that artificial recharge will prove to be an important method for increasing water supplies in specific areas.

Conversion of brackish water. The desalting of sea water for fresh-water use has been demonstrated to be economically feasible. Recent costs of conversion are about one and one-half times the cost of present-day municipal water in Arizona. However, the large industrial and municipal areas are more than 100 miles from the nearest seacoast, and Tucson is 2,500 feet above sea level. The cost of transport would be around 300 dollars per acre-foot compared to water at eighty dollars per acre-foot today. The possibility of converting the brackish or saline waters in the groundwater basins for municipal use is greater than the possibility of conversion of sea water. Certain zones in the subsurface reservoirs contain salty water that is blocked from entering wells. The amounts and distribution of these waters are not well known, but when costs became comparable the brackish groundwater reserves will offer a potential source for future years.

Vegetation modification. Some experts believe more water can be obtained by eradication of juniper and piñon, by thinning ponderosa pine, and by strip-

cutting in spruce-fir areas. At the lower altitudes, chemical treatment is used to eradicate chaparral and other vegetation with the hope of increasing runoff from the land surface. State and federal agencies are conducting many experiments to test the practicability of these measures. Preliminary estimates indicate it might be possible to increase the runoff in the Salt River watershed about 280,000 acre-feet of water annually. This is an appreciable quantity of water, but the cost of production must also be equated.

Many of the stream channels in Arizona are choked with willow, saltcedar, sycamore, and other water-loving vegetation. These plants consume large quantities of water from the shallow groundwater table and convert it into vapor. Salvage of this water would provide large supplies for beneficial use. The eradication of these non-beneficial plants is not an easy matter. Many methods have been tried, but the plants come back in more vigorous growth. One of the most efficient methods of destroying saltcedar is to lower the water table quickly beyond the root system. Multipurpose planning for the best interests of all is necessary to obtain maximum benefit from water in Arizona. Otherwise much water will continue to be lost to the atmosphere.

Arizona's history has been and will be closely associated with water development. The continuing growth of population and industry will demand ever-increasing quantities of water. Fortunately, water to meet this demand is available from several sources. The choice of selection will be based on many economic and legal factors. The physical conditions relating to water table decline by groundwater withdrawal are not well known. However, such knowledge is increasing rapidly, and scientific regulation and management can be utilized when the demand is sufficiently urgent. With proper conservation and intelligent exploitation of Arizona's water supplies, the citizens of Arizona could prepare for a long and prosperous future.

Irrigation Projects and Irrigated Areas

THE SALT RIVER PROJECT. As in most parts of the world, early water development in Arizona was from surface water supplies. Although irrigation has been practiced by White men in Arizona for nearly a hundred years, the Indians irrigated land in the Salt River Valley more than a thousand years ago. Extensive Indian irrigation ended around 1400 A. D., possibly due to prolonged drought conditions.

However, tribes such as the Pima were using irrigation on a small scale, by diverting water directly from streams onto their fields, at the time the Spanish entered the state.

Most of the farmers who migrated westward in the early Territorial days in search of gold or other quick riches found nothing more profitable than a job working for wages. But they noted the thousands of acres of fertile soil in the flat, wide, flood plain of the Salt River Valley near the village of Phoenix and realized that only water was needed to make the land productive. Apparently sufficient water was available from the river. All that seemed to be needed was to go upriver far enough to develop the elevation necessary for gravity flow, improvise a headgate, construct a canal, and lead the water out onto the land. The first canal company was organized in 1867 and the project was a success. By 1880, nine additional canals had been built and 55,000 acres were under cultivation. The area prospered, despite the occasional floods which washed out the flimsy diversion dams and deposited silt in the canals. But in 1897 a drought descended upon the Valley. There was no rain in the mountains and the flow of water dwindled to a trickle. The drought continued through 1898-99. What had been a growing and prosperous community all but faded into oblivion. The drought was broken early in 1900 by a flash flood which washed out all of the diversion dams and with them the prospect of a spring crop.

The farmers of the area realized that more adequate methods would have to be devised to control the river. The answer seemed to be a large dam to store the water and to regulate its flow. A good site for a storage dam was found, about eighty miles east of the area, at the confluence of the Salt River and Tonto Creek. But the cost of construction of such a dam was too great for local financing, so emissaries were sent to Washington to appeal to Congress. Persuading Congress to act was not easy, but with help from President Theodore Roosevelt, the first reclamation act was passed by Congress in 1902. However, before any funds would be spent upon this Salt River project, it was necessary for the land owners in the Valley to settle all disputes, to reconcile water rights, and form some sort of an association with which the Bureau of Reclamation could deal. Eventually this was accomplished by the formation of the Salt River Valley Water Users' Association — the first of its kind.

Under the Bureau of Reclamation, construction

of Roosevelt Dam was begun in 1905. It was opened for delivery of water in 1911 and completed the following year. Its reservoir, Roosevelt Lake, is 17,500 acres in area, and has a storage capacity of 1,420,000 acre-feet. Following completion of the dam, a power plant was constructed at its base. The final cost of the dam and power plant was \$5,560,000, but this was not the entire cost of the project, for an adequate diversion dam had also to be built. This was located at Granite Reef, thirty-two miles east of Phoenix, and cost \$627,000. Much additional work had to be done on the distribution system. This included three small hydroelectric power plants in the main canal system. The Bureau of Reclamation operated the project for some years, but not to the satisfaction of the water users. A dispute arose about the allocation of the power generated. As the Bureau of Reclamation was anxious to rid itself of the problems of project operation, in 1917 the whole project was turned over to the Salt River Valley Water Users' Association, it being agreed that the Association owed the Bureau \$10,166,021.97. This was paid off in 1955. To operate the Project, officially known as the Salt River Project, a subsidiary group called the Salt River Agricultural Improvement and Power District was formed.

By 1920 Roosevelt Dam had overflowed four times and precious water lost. To provide additional storage facilities and hydro-power Horse Mesa, Mormon Flat, and Stewart Mountain dams were constructed on the Salt River below Roosevelt Dam at a total cost of \$10,584,000. The combined storage capacity of the reservoirs created by these dams is 374,755 acre-feet. The Association has one diesel plant and several large steamplants for power generation and in addition is a large purchaser of Colorado River power. Storage has been increased by the construction of the Bartlett and Horseshoe dams on the Verde River. The Association now has the most completely integrated irrigation and power system in the West with almost 100 percent utilization of the flood waters of the Salt and Verde rivers. Not since 1941 has there been any waste of water over the spillways of this system of dams. The Association owns 239,000 acres of irrigable land, and has available a total of about 2,077,000 acre-feet of storage capacity.

Water users in the Project have three types of water rights as follows: (1) normal flow rights with priorities from 1869 to 1909 on 151,000 acres; (2) stored and developed water rights with equal rights



— Phoenix Chamber of Commerce

Roosevelt Dam — first dam on the Salt River

for Project lands; (3) special pump-water rights on about 155,000 acres which have been acquired through contract with the Association. For the past ten years the Association has had available for Project use an average of about 800,000 acre-feet of gravity water for diversion at Granite Reef and about 400,000 acre-feet of pumped water per year. Water was delivered to 169,000 acres within the Project in 1958.

Lands remain in the Project whether they are under cultivation or have been subdivided. However, the city of Phoenix has taken over the distribution of domestic water in many areas which have been annexed. By contract with the Association, the city of Phoenix now pays the assessments levied against those subdivision lots on which irrigation service has been discontinued. In return, the Project delivers the water which formerly went to these lands to the city filtration plant on the Arizona Canal. In May of 1959 the Project was furnishing about 85 percent of the total water supplied to the city's 300,000 customers. At the end of 1958 the Project had 99,971 accounts, of which 71,983 were regular accounts, and 27,988 were city accounts where water was still being delivered to lands no longer under cultivation.

The Association is obligated also to deliver annually up to 40,000 acre-feet to United States Indian lands, and water for a few thousand acres under contract to small irrigation enterprises. In

addition, through contract and court decrees, 6.9 percent of the diversions at Granite Reef are delivered to the Roosevelt Conservation District and the Buckeye Irrigation District.

Water costs in the Project are very low compared with most other areas in the state. This is due primarily to the increasingly large revenue received from the sale of power which has been used in part to pay for construction of irrigation facilities and to reduce operation charges to water users. Charges for water in 1958 and 1959 were \$1.25 per acre-foot for the first two acre-feet, \$3.50 for the next acre-foot of developed or normal flow water, and \$7.50 per acre-foot of water from pump rights.

OTHER PROJECTS IN THE SALT RIVER VALLEY. The irrigated area in Maricopa County in 1959 is estimated at 520,000 acres. Over 90 percent of this acreage is in the Salt River Valley. The irrigated area in the Valley has extended far beyond the boundaries of the original Salt River Project. Much of this expansion occurred in the 1920's under the district form of irrigation enterprise. The more recent developments have been entirely pumped water from wells and have been mainly under private ownership.

The Roosevelt Water Conservation District containing approximately 37,000 acres was organized in 1920. It is located immediately east of the Salt River Project and its principal source of water supply is from wells located within the District boundaries. The District also has available gravity water from storage and flood waters of the Salt River amounting to about 40,000 acre-feet per year on the average. The major portion of this water requires a pump lift of about fifty-five feet.

Farther to the southeast is located the Queen Creek Irrigation District securing its entire water supply from wells. The irrigated area has been extended in this same direction, under private ownership with water from wells, to within a few miles of the town of Florence on the Gila River.

South of the Salt River Project boundary and extending to the Gila River Indian Reservation practically all of the irrigable lands have been placed under irrigation with pumped water.

Northwest of Phoenix and near the edge of the Salt River Valley is located the Maricopa County Municipal Water Conservation District No. 1, organized in 1925, with over 39,000 acres within its boundaries. The District obtains about one-quarter of its delivered water supply from the Carl Pleasant

Dam and Reservoir on the Agua Fria River. The remainder is supplied by water from deep wells, supplemented by pumped water from privately owned wells.

The Roosevelt Irrigation District containing 38,000 acres was organized in 1923. It occupies a strip about three miles in width and twenty-four in length, extending from the Agua Fria River on the east to the Hassayampa River on the west. The District obtains its water from wells, forty-six of which are located within its boundaries and fifty-five located in the lower end of the Salt River Project. The Project wells were originally drilled for drainage purposes. They are now operated by the District under contract with the Salt River Valley Water Users' Association to supply water to District lands. Water from Salt River Project wells is conveyed to the Agua Fria River in concrete-lined canals to a flume across the river and thence in a concrete-lined main canal for twenty-six miles to the lower end of the area. About three-quarters of the water supply is from Project wells, and the balance is from wells within the District.

The Buckeye Irrigation District of over 18,000 acres lies along the Gila River south of the Roosevelt Irrigation District. Its water supply is obtained partly under court decree from the Salt River Valley Water Users and the balance by pumping from about forty-five District-owned wells.

Immediately above the Gillespie diversion dam are located the lands under the Arlington Canal, comprising several thousand acres irrigated with return flow from the Buckeye District and with water from a few large-capacity wells.

Practically all the irrigable land between the organized irrigation projects and extending northward into Deer Valley and along the Agua Fria and New rivers has been developed with pumped water supplies. In some instances the development has been under corporate ownership of several thousands of acres such as that of the Goodyear Cotton Company at Litchfield Park and the Boswell Cotton Company near Marinette.

THE UPPER GILA RIVER VALLEY. The irrigated area along the Upper Gila River is concentrated principally in the Safford Valley with 32,500 acres, and in the Duncan Valley with about 5,200 acres. Crop irrigation in the former area was begun about 1872 and in the latter area in 1879. These areas have water rights to gravity flow from the river established in accordance with the federal court

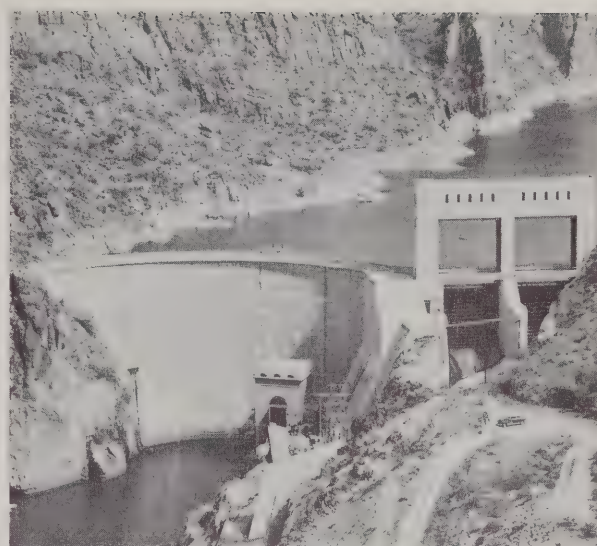
decree of 1935, with priorities on a small percentage of the lands dating back to the early 1870's. Diversions from the Gila River in 1958 were made by eleven canal companies in the Safford area and by five canal companies in the Duncan area, the total amounting to 165,000 acre-feet. The various canal companies are organized as mutual water companies with each maintaining and operating its own irrigation system. However, when joint action of all the water users is desirable they function as the Gila Valley Irrigation District in the Safford area and as the Franklin Irrigation District in the Duncan area. The actual apportionment and distribution of waters to the water companies is made by the federal water commissioner.

The lands are dependent upon the unregulated flow of the river for gravity water. Recurring shortages of water supply during the summer months led to the drilling of wells by private individuals and by many of the canal companies to augment the supply of natural flow waters. Most of the well water is high in total soluble salts and inferior to the gravity water for irrigation. Even a limited amount of storage on the Gila River above the irrigated lands would be of immense value to these areas.

In addition to the lands having gravity water rights there is a small area near Artesia of about 1000 acres obtaining its water supply from artesian wells. Pumps are required in most of the wells.

CASA GRANDE VALLEY AND ADJACENT AREAS. Irrigation in the Casa Grande Valley centers about the San Carlos Project of 100,000 acres for which construction was completed in 1928. This is an an Indian Service project providing for the irrigation of 50,000 acres of land on the Gila River Indian Reservation at Sacaton and 50,000 acres of non-Indian land in the vicinity of Coolidge, Florence, Eloy, and Casa Grande, but the total acreage has never been placed under irrigation. The non-Indian lands are all included in the San Carlos Irrigation and Drainage District and, through contract with the U. S. Bureau of Indian Affairs, water users secure water from the San Carlos Project. Water is obtained from three sources: stored water, pumped water, and normal flow water.

To control the flow of water for this project, Coolidge Dam was built on the Gila River some twenty-five miles southeast of Globe at a cost of \$5,500,000. The reservoir which it formed is known as San Carlos Lake and has a capacity of 1,300,000 acre-feet, but the maximum storage attained has been



— Salt River Project

Mormon Flat Dam on the Salt River

only a little more than 800,00 acre-feet in 1942. The Ashurst-Hayden diversion dam was built about ten miles above Florence. The gravity water supply, which varies from year to year, has been supplemented with an average of 90,000 acre-feet of pumped water per year. Crop acreage is adjusted to the water supply and has varied from a minimum of 26,000 to a maximum of 46,000 acres on non-Indian or White lands. The average irrigated acreage of Indian lands on the Project in the past ten years has been 20,000 acres per year and on the White lands approximately 30,000 acres.

In 1933 a small hydroelectric plant was constructed at Coolidge Dam, and power lines run to Hayden, Mammoth, and the irrigation project at Coolidge. A diesel standby plant was also constructed at the town of Coolidge.

The most urgent need of the San Carlos Project is additional storage below the mouth of the San Pedro River so that the presently wasted flood waters of this stream may be salvaged. The construction of a high dam at the Buttes site, advocated by the water users for many years, would provide storage, flood protection, and silt control.

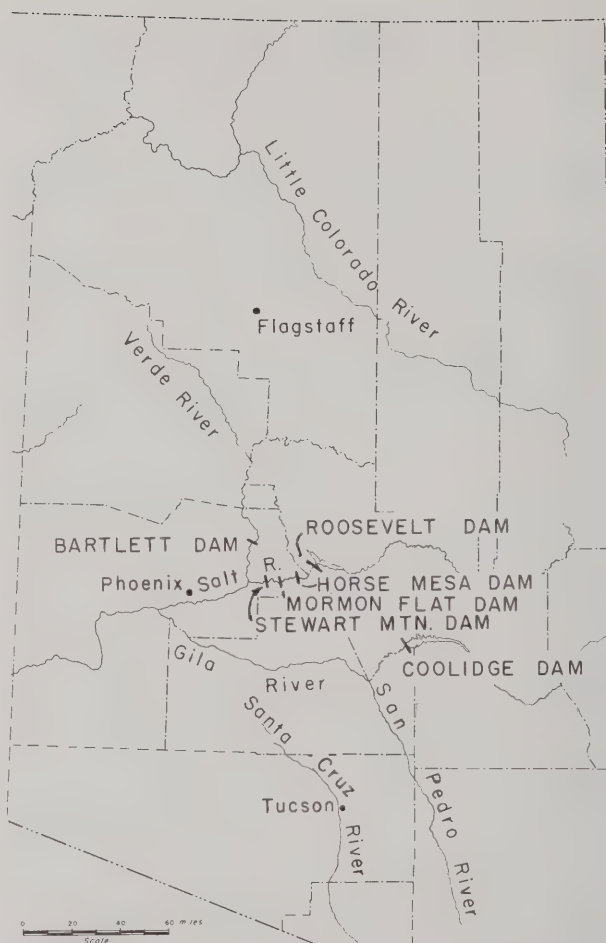
The San Carlos Irrigation and Drainage District occupies areas adjacent to Coolidge and Casa Grande, and the Indian lands located along the Gila River. Practically all of the irrigable land between the designated Project areas and extending southward through the Eloy district to the Pinal-Pima County line has been developed with pump water supplies.

West of Casa Grande, and including the Maricopa and Stanfield district as far south as the Papago Indian Reservation, irrigation development has been entirely with pumped water. It is estimated that the irrigated area included within the Casa Grande Valley contains approximately 230,000 acres wholly dependent upon groundwater supplies.

COCHISE COUNTY LANDS AND THE SAN PEDRO VALLEY. The irrigation water supply is obtained almost entirely from privately owned wells which, compared with those in other major pump areas in the state, are of small capacity — less than 1,000 gallons per minute, except in the Kansas Settlement and Bowie areas. A survey by the Soil Conservation Service indicates an irrigable acreage in the county of about 120,000 acres of which approximately 76,000 acres were irrigated in 1959. It is estimated that about one-half of the irrigated acreage is concentrated in the Kansas Settlement areas, and south of Cochise Dry Lake. The other important irrigated areas are northwest of Willcox, along Whitewater Draw in the southern end of the Sulphur Spring Valley, and in the Bowie-San Simon district. There are scattered small areas between the Mexican boundary and Redington. The Benson and the St. David Canal companies furnish a limited water supply of gravity water by diversion from the San Pedro River for several hundreds of acres adjacent to the towns of the same name. However, most of the land along the San Pedro is irrigated with pumped water.

Between Redington and the mouth of the river at Winkelman there are small scattered areas on the bottomland irrigated with pumped water from shallow drilled wells. A few small gravity ditches diverting water from the San Pedro River are still in existence, but the supply is supplemented with pumped water. The irrigated acreage can be only roughly estimated and probably does not total more than 5,000 acres.

SANTA CRUZ VALLEY. Irrigation development from Tucson south to the Mexican boundary has been confined primarily to the narrow strip of bottom-land on both sides of the Santa Cruz River. Pumped water from wells averaging between 200 and 300 feet in depth with capacities usually of less than 1,000 gallons per minute is used almost exclusively. A crop survey along the Santa Cruz River in Santa Cruz County showed 4,650 acres under irrigation in 1959; most of this has been under irrigation for many years. This portion of the Santa Cruz Valley is one of the few pump areas in the



Dams on the Salt, Gila, and Verde rivers

state in which the groundwater has not been seriously lowered as the result of pump draft. Opportunities for recharge from flood flows in the river are excellent and the irrigable acreage is limited to the narrow bottom land. The largest concentration of land under irrigation is in the Sahuarita-Continental district above Tucson where the bottomland is more than a mile in width.

Urban development in the vicinity of Tucson has replaced agriculture and there is little pumping for irrigation for a distance of seven or eight miles above and below the city. The acreage under pump irrigation in the Cortaro area has also decreased but is still being pumped to augment the supply in the Marana district.

The largest area under irrigation in Pima County is located in the Marana-Avra Valley district where the Santa Cruz Valley widens out and is joined by the Avra Valley near Marana. Pump capacities of

wells in the district are between 2,200 and 2,250 gallons per minute. The total irrigated acreage in 1959 in the district was about 32,000 acres, of which 7,600 acres received water from the Cortaro Water Users' Association.

This Association is organized as a non-profit corporation under the laws of the state, with each water user holding one share of stock for each acre of land within the Association boundaries. The Association operates and owns the wells and the distribution system of canals and laterals. Water costs in 1959 were \$8.00 per acre-foot, plus an annual assessment of \$2.50 per acre.

The total irrigated acreage in Pima County in 1959 was estimated at about 58,000 acres.

IRRIGATED AREAS IN CENTRAL AND WESTERN ARIZONA. The expansion of irrigated acreage in recent years has taken place largely through the development of groundwater supplies in the central and western semi-desert valleys of the state. The area under irrigation may vary considerably from year to year in any one region but in general there has been an increase. The approximate acreages in the various districts in 1959 are as follows:

Rainbow Valley and Waterman Wash. These districts are adjacent and are located just south of the lower end of the Salt River Valley and the Gila River. The estimated acreage under irrigation in Rainbow Valley, which drains west into the Gila River, was about 6,000 acres in 1959. The Waterman Wash area drains north into the Gila River and had an irrigated acreage in 1959 of about 12,000 acres. Both districts are entirely dependent upon wells.

Gila River Valley, Gillespie Dam to Painted Rock Dam. This district includes some lands adjacent to the Gila River with gravity water rights, but because of inadequate water supply has been dependent upon supplemental pump water for many years. The two largest areas with gravity water are the lands under the Enterprise Canal and those in the Old Gillespie Project. The number of acres under irrigation in the latter has varied greatly during the last twenty years. Development has been mainly on the bottom lands on both sides of the Gila River and on the mesa lands west of Gila Bend. The total acreage under irrigation in this district in 1959 has been estimated at 65,000 acres.

Gila River Valley, Painted Rock Dam to Wellton-Mohawk Project. Scattered areas on both



— San Carlos Irrigation Project

Coolidge Dam on the Gila River

sides of the river have been developed in this district, but are concentrated principally south of the river below the Painted Rock Dam and north of the river in the lower end of the Palomas Plain. This district as well as most of the area along the lower Gila River has waters with a higher soluble salt content than is desirable for irrigation. The irrigated acreage in 1959 has been estimated at approximately 17,000 acres, all dependent upon well water.

Tonopah and area west of Hassayampa River. This district has developed rapidly since 1952 and is now reported to have an irrigated area of almost 25,000 acres. It is entirely pump irrigated with depths to water ranging from less than 15 feet near the Hassayampa River to almost 250 feet northwest of Tonopah.

McMullen Valley. About 14,000 acres are reported under pump irrigation in this district which extends from above Aguila in the east end of the valley to Salome at the west end. Development has been concentrated principally in the area north of Aguila in the last few years. Depths to water range from less than 100 feet to about 400 feet on the valley slopes in the upper end of the valley in irrigation wells.

Harquahala Plains, Centennial Wash. The irrigated lands are located in two principal areas, the

Harquahala Plains in the northwest end of the valley and along Centennial Wash above the Gila River. The irrigated area has almost doubled in the last few years in the upper end of the valley and is estimated to be about 25,000 acres in the entire district. There is a wide range in depths to water in each of these two areas, between 25 and 225 feet in lower Centennial Wash and between 30 and 375 feet in Harquahala Plains.

Yavapai County areas. The irrigated areas are located in the small valleys in the mountain section of central Arizona. The main areas are Skull Valley and Kirkland Creek, Chino Valley, Big Chino Valley, and the upper Verde River Valley. The total irrigated acreage in 1959 was less than 20,000 acres.

Skull Valley occupies a small area on a tributary of Kirkland Creek about fifteen miles west of Prescott. The irrigated area in Skull Valley, with that along Kirkland Creek, does not exceed a couple of thousand acres. Most of the farming in this area is combined with cattle ranching. Water supply is obtained from wells which are relatively shallow and of low capacity.

Chino Valley is located about twenty miles north of Prescott with part of the irrigated area in the Chino Valley Irrigation District, which obtains its water supply from two small storage reservoirs on Willow Creek and Granite Creek located just north of the city of Prescott. The District contains slightly over 2,500 acres and over a period of years has had an inadequate supply for its irrigation requirements except in exceptionally wet years. Probably less than half of the District acreage on the average is in crop. The remainder of this area obtains its water from wells in the Chino Valley artesian basin. Except for a small area in the north end of the basin, the wells are non-flowing and must be pumped. The area is unique in that the artesian water is found in buried, fractured lava flows. The acreage irrigated from pumped and flowing wells has remained nearly constant during the last four or five years at approximately 4,000 acres.

Big Chino Valley which begins about twenty-four miles north of Prescott and extends northwestward along Chino Creek for a distance of about twenty-five miles is irrigated entirely from wells. Chino Creek may be considered as the beginning of the Verde River since it is known by that name from the lower end of the valley. This area has developed rapidly in the last few years in comparatively large units that were formerly cattle ranches. The area is not in-

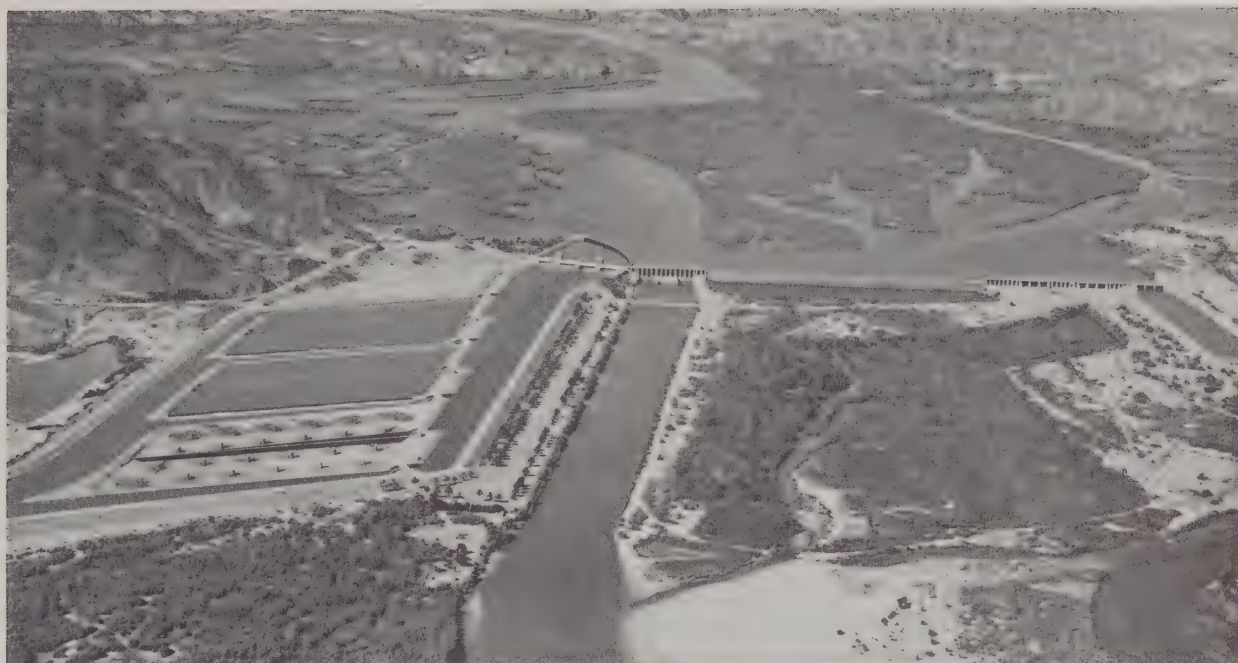
tensively farmed and large parts of the irrigated acreage are still in the development stage. The total acreage under irrigation in this district was about 8,000 acres in 1959.

The upper Verde River Valley District consists of small acreages located principally on both sides of the Verde River and along Oak Creek, Beaver Creek, and Clear Creek. The district extends from a few miles north of Clarkdale for a distance of about twenty-five miles down the Verde River. Irrigation water supplies are primarily from gravity diversion from the Verde River and tributary creeks. The individual farms in this district are comparatively small with numerous individual diversion headings with old established water rights. Along the Verde River alone there are twenty-five small ditches for the irrigation of lands having water rights on an area of a little over 3,000 acres. Established water rights are held for a little over 1,600 acres in Oak Creek and for about 1,000 acres on Beaver and Clear creeks.

In addition to the areas listed above, there are irrigated areas on Date Creek, on the Hassayampa River near Wagner, and on the Agua Fria River near Dewey. The aggregate acreage under irrigation is probably not over 1,400 acres, almost entirely from pump water supplies.

Little Colorado River areas. The irrigated lands in Coconino, Apache, and Navajo counties are located principally along the Little Colorado River, Silver Creek, and Show Low Creek. The total acreage under irrigation in 1959 is reported to have been less than 27,000 acres. The water supply is principally by direct diversion from stream channels or from storage in small reservoirs near the headwaters. However, there has been some increase in recent years in the use of pumped water from wells in the Taylor-Snowflake and Hunt districts and also along the Little Colorado River in the vicinity of Holbrook. Most of the irrigated lands are located fairly close to the drainage divide with limited drainage area above them and storage is confined to reservoirs of small size. During wet years the reservoir capacity is insufficient for the storage of spring runoff, and in dry years the water supply is inadequate for the irrigable lands. Most of the water users are organized as mutual water companies which operate and maintain their own storage reservoirs, diversion structures, and distribution systems.

The largest area of irrigated land is located near St. Johns and obtains water in part from the Lyman Dam on the Little Colorado River. Water



— U.S. Bureau of Reclamation

Imperial Dam and desilting works on the Colorado River

stored above this dam is used on about 3,000 acres of the Lyman Water Company land. This company also supplies part of the water used on 3,300 acres of the St. Johns Irrigation Company, which obtains additional water by direct diversion. About 4,900 acres are under irrigation in the Springerville-Eagar district with water from three small storage reservoirs and diversions from the Little Colorado River. Between Lakeside and Show Low on Show Low Creek and between Shumway and Snowflake on Silver Creek, additional lands are under irrigation with water primarily from gravity diversions and stored water from the Daggs Reservoir on Silver Creek. There is also a small area of between 300 and 400 acres near Concho, which obtains water from Concho Reservoir. The principal irrigated areas along the Little Colorado River are in the vicinity of Hunt with pump water from non-flowing artesian wells, near Woodruff by diversion from the river, and in the Holbrook-St. Joseph district with water from wells, and a limited amount by diversion from the Little Colorado River.

In addition to the larger impoundments of surface water, there are a number of small dams and lakes which collect flood waters for municipal and stock purposes. The city of Flagstaff reservoirs on Walnut Creek have a total storage of 35,000 acre-

feet. The city of Williams and several other communities depend on surface water for their sole supply. Ranchers and stockmen have long employed the construction of small earthen dams and tanks to provide water for their livestock. These structures help conserve the land from erosion and arroyo-cutting in addition to supplying water. Unfortunately, much of this impounded water is lost to evaporation and may contribute to the decrease in over-all runoff observed in recent years.

COLORADO RIVER LANDS. The lands irrigated with Colorado River water constitute the largest and almost the only area of any size in the state deriving its entire water supply from gravity sources. Development has been mainly by the Bureau of Reclamation through the construction of the Yuma Project, authorized in 1904, and the Gila Project, as re-authorized in 1947. The construction of Hoover Dam and the later construction of the Davis and Parker dams has insured the lands along the lower Colorado River of flood protection and an ample water supply. Presently, surplus water from the Upper Colorado River Basin states is available and wasted into the Gulf of California. During the filling period of the reservoir above Glenn Canyon Dam, now under construction near Lees Ferry, these surplus waters may not be available below the dam site.

The irrigated areas are located on the bottom lands adjacent to the Colorado and Gila rivers and also on the higher mesa lands. The bottom lands with shallow water tables have to contend with drainage problems. These lands comprise the only irrigated areas of any size in Arizona in which drainage may be considered a major problem. The mesa lands, except in a few isolated cases with perched water tables, do not have drainage problems. The larger irrigation enterprises along the Colorado River include the following:

Yuma Project. The Arizona water users in this Project were organized as the Yuma County Water Users' Association in 1903 to contract with the Bureau of Reclamation for their part of the construction of the Laguna diversion dam, irrigation, and drainage facilities. Yuma Valley has one of the oldest water rights on the Colorado. By 1904 about 10,000 acre-feet were diverted by pumps and gravity flow through more than fifty miles of canals, but were dependent on unregulated flow. Upon completion of Hoover Dam in 1935 the impoundment of flood waters in Lake Mead assured constant flow and nearly sediment-free water.

The Yuma Project occupies the bottom lands between Yuma and the Mexican boundary. Since 1941 water has been diverted at the Imperial Dam and carried through the All-American Canal, and thence by canal to the siphon crossing the Colorado River to the Yuma Valley. The Association has for many years maintained and operated the irrigation and drainage system for the 52,000 acres in its boundaries, of which 45,000 are under irrigation. The operation and maintenance costs are obtained by water charges which on most of the lands amount to \$13.00 for the first five acre-feet and additional amounts at \$1.50 per acre-foot. Most of the land is now exempt from repayment charges for construction costs, which have largely been repaid. Total water costs on the major portion of the lands are thus about \$13.00 per year per acre.

Yuma-Mesa Division of the Gila Project. Under the Re-authorization Act of 1947 this part of the original Gila Project was reduced to 40,000 acres to be irrigated from Colorado River water diverted at the Arizona heading at Imperial Dam. It is comprised of three units, the North Gila and the South Gila units of 15,000 acres and the Yuma-Mesa Unit of 25,000 acres.

Most of the irrigated lands in the North Gila Unit are within the North Gila Valley Irrigation

District, which operates and maintains the irrigation system and drainage facilities. The District is comprised of 7,050 acres located in the Y between the Gila and Colorado rivers. Of this District, 6,300 acres were under irrigation in 1958. Several hundred additional acres secure water directly from the Gila Gravity Main Canal through contract with the Bureau of Reclamation. This District probably has the lowest water cost of any area in the state. Water charges are \$6.00 per acre-foot, quantity unlimited, and District assessments for all purposes in 1958 were only \$3.60 per acre-foot.

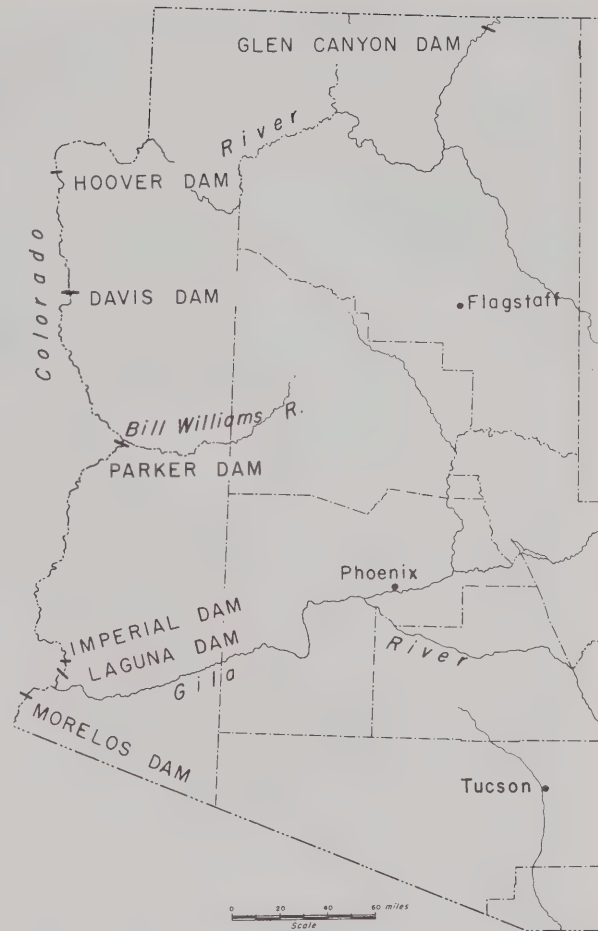
The Yuma Irrigation District, organized in 1919, is located on the bottom-lands south of the Gila River just east of Yuma. There are about 11,000 acres within the District boundaries of which about 10,000 acres were irrigated in 1958. The District is primarily an electric district supplying power to land-owners for the operation of private wells. The District owns and operates the substations and transmission lines. The water supply is from large-capacity drilled wells of between 150 and 200 foot depth. The water costs are comparable with those in the North Gila Valley Irrigation District with district assessments only \$1.00 per acre in 1958 and power costs three-fourths of a cent per kilowatt hour. The district has no contract for water from the Bureau of Reclamation although its lands are included with those designated as part of the Yuma-Mesa Division of the Gila Project. Two problems confront the water users, the increasingly high salt content of the well waters and seepage from irrigation of the mesa lands to the south.

The Yuma-Mesa Unit is under the operation of the Bureau of Reclamation with the Yuma-Mesa Irrigation and Drainage District representing the water users with over 14,000 acres under irrigation in 1958. The Unit occupies the mesa extending from Yuma to the Mexican boundary. The construction costs were high for this unit and the contract for repayment extends over a period of sixty years, with only nominal payments during the development period of the first ten years. Water is diverted from the Imperial Dam in the Gila Gravity Main Canal and delivered to Mesa Unit through a fifty-two-foot pump lift at the Yuma-Mesa pumping plant. Water requirements on the sandy mesa land are greater than for most areas. Charges in 1959 were \$13.05 for the first nine acre-feet and \$1.50 per acre-foot for each additional acre-foot, with District assessments of \$2.50 per acre, plus annual construction.

The Unit B Irrigation and Drainage District, organized in 1947, consists of 3,000 acres of mesa land south of Yuma, designated as the Yuma Auxiliary Project. Between 1922 and 1953 its water supply was obtained from the Yuma Project main canal with a pump lift to the mesa and since 1953, from the canal system of the Yuma-Mesa Unit. The Bureau of Reclamation reports 2,992 acres irrigated in 1958 with water charges of \$13.50 for the first four and one-half acre-feet and \$2.25 for each additional acre-foot. The District assessments were \$5.04 per acre including annual payments on rehabilitation and construction costs.

Wellton-Mohawk Division of the Gila Project. The 75,000 acres of this division are located on both sides of the Gila River, beginning about 15 miles east of Yuma and extending almost fifty miles up the river. About 60,000 acres are bottom land and 15,000 acres are on the mesa. The distribution system is operated and maintained by the Wellton-Mohawk Irrigation and Drainage District with approximately 45,000 acres under irrigation in 1958. Water is delivered to the District canals from Gila Gravity Main Canal in three pump lifts of thirty-one, sixty-four, and fifty-five feet. District assessments are \$2.00 per acre per year in addition to water charges for a minimum of \$12.50 for five acre-feet of water, plus payments on construction costs which are small during the development period. Additional water is supplied at \$2.50 per acre-foot for irrigation and at \$1.00 per acre-foot for leaching purposes. The District has drainage problems at the lower end of the area near Dome and in some locations on the bottom land at the edge of the mesa escarpment.

Colorado River Indian Reservation. This is a U. S. Indian Service project constructed and operated by this agency. Water is diverted at the Headgate Rock Dam for the irrigation of approximately 31,000 acres of bottom land, located south of Parker. About 11,500 acres are farmed by Indian owners or leasers and the remainder by White leasers. The current water charges are very low — \$6.00 for the first five acre-feet on average soil and \$8.00 for the first eight acre-feet on sandy soil with excess water at \$1.50 per acre-foot. The drainage problems in this area are serious, and construction of additional drainage facilities and the concrete-lining of canals are continuing. Future expansion to an irrigated area of 100,000 acres of bottom land and 25,000 acres of mesa land is possible.



The dams of the Colorado River

Other Colorado River lands. Pumping from the Colorado River or from wells provides a water supply for several thousand acres of scattered, privately owned lands along the river. Two of the larger areas are 1,600 acres below Ehrenberg and 6,500 acres in Cibola Valley. Some of the lands now under irrigation on the bottom land adjacent to the river have been acquired under squatters rights, and title to them is in controversy.

Control and Use of the Colorado River

The Colorado River, with its main tributary, the Green, is 2,700 miles long and drains an area of about 244,000 square miles, including practically all of Arizona. About 43 percent of the drainage area is within the boundaries of Arizona, and about 700 miles of the river's stream bed are wholly within Arizona or along its western boundary.

In the early Territorial days the river was navigated north of the mouth of the Bill Williams River.

But navigation was difficult due to stream velocity and the vagaries of the uncontrolled river. Stream flow on the lower reaches varied from a trickle to devastating floods. At the present time, except for a few small boats, navigation is of no importance, but the United States Supreme Court has declared the river navigable. Consequently, its main stream of water is subject to federal control and can only be distributed in accordance with federal law.

Along the boundary which the Colorado forms between Arizona and California, much of the land on the Arizona side is high, that on the California side low. This topography makes it difficult for Arizona, but easy for California, to acquire prior rights by putting the water to beneficial consumptive use. There are thousands of tillable acres in California's Imperial Valley immediately west of the lower reaches of the river. Much of this land is below sea level. This makes the delivery of water for irrigation easy, but danger of floods great. The river carries enormous amounts of delta-building silts. As the delta forms, and blocks the exit channels, the river bed rises, thus increasing the danger of overflowing. In 1890-91 the river broke its west bank, flowed into the Imperial Valley, and formed the Salton Sea. In 1900-1902 a canal was constructed and irrigation begun in the Imperial Valley. Against the advice of engineers, the land owners made a breach in the west bank of the river for convenience in getting a larger supply of water. The engineers were right; for a flood came and quickly eroded a large channel through this breach. For some sixteen months the whole flow of the Colorado emptied into the Imperial Valley, doing about \$3,000,000 worth of damage. This was before the days of federal disaster aid, and had it not been for the work of the Southern Pacific Railroad the whole of the Imperial Valley would probably be a sea today, through which the waters of the Colorado would flow to the Gulf of California. At a cost of between \$2-3,000,000, the Southern Pacific transported and dumped trainload after trainload of stone and gravel into the breach. Eventually, the breach was closed and a dike built along the west bank strong enough to contain the river in its old channel. Later the Southern Pacific received a partial payment from the federal government for its work.

In 1903, the Yuma County Water Users' Association was formed, and the use of water authorized. But only a small area could be irrigated on the Arizona side of the river. In 1905-09 the Laguna Diversion Dam was built a few miles above Yuma

and the Imperial Canal constructed on the California side at a total cost of \$21,100,000. Laguna was a low, wedge-shaped dam, which spanned the river and raised the level of the water on the upstream side high enough to divert water through the head-gate into the canal. The dam was designed to prevent erosion of the riverbanks during floods. In 1912, at a cost of \$667,648, a siphon was constructed to carry water from the Imperial Canal to irrigate by gravity an area just south of Yuma. Thus was born the Yuma Valley Project.

The Boulder Canyon Project. In 1918 the Bureau of Reclamation proposed the construction of a large dam in Boulder Canyon on the Colorado as the best means of preventing floods, storing water for irrigation, controlling the flow, and developing power. This proposal caused much controversy among the Colorado River basin states. Bill after bill was introduced into Congress requesting studies and appropriations for developments. Most of these proposals were introduced by California for its benefit and were not supported by Arizona. Congress was reluctant to appropriate funds for the Boulder Canyon Project unless and until six of the seven basin states, including California, reached some sort of agreement as to the allocation of water. After several attempts, representatives of the seven states (Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming) drew up a compact in 1922 which designated the drainage area of the river above Lees Ferry in northeastern Arizona as the upper basin, and that below as the lower basin, and allocated half of the river's anticipated annual flow of 15,000,000 acre-feet to the upper basin and the other half to the three lower basin states — Arizona, California, and Nevada. All of the states ratified the Colorado River Compact except Arizona.

With the ratification of the Compact, Congress passed the Boulder Canyon Project Act which appropriated funds for the Project and authorized the Secretary of the Interior to make contracts for water and power with any state that had ratified the Compact. Limits were set of 4,400,000 acre-feet of water for California, 2,800,000 for Arizona, and 300,000 for Nevada. This did not meet with the approval of Arizona, but California went right ahead making contracts for water and power and putting both to use. The California legislature did, however, have to pass an act limiting its use of water to the allotted 4,400,000 acre-feet in order to obtain approval of its contracts. Arizona tried to halt California's appro-



Hoover Dam in Boulder Canyon on the Colorado

— U.S. Bureau of Reclamation

priation of water by recourse to the courts but found it had no standing due to its failure to sign the 1922 Compact. In 1944, Arizona finally signed.

Following the initial Boulder Canyon proposal, full engineering and geologic studies were made of the proposed dam and reservoir sites. A nearly

perfect dam site was found in the Black Canyon, immediately below Boulder Canyon, and plans were made to locate the dam in this canyon. Here the canyon was narrow, the walls high and almost vertical, and the rock of the walls hard and solid. There were, however, many problems to be solved, and

many competent engineers were skeptical of the entire Project. Their doubts were unfounded for the dam was completed without incident.

Construction of the dam, a gravity arch type, was begun in 1931 and completed in 1936. Originally called Boulder, and later named Hoover, the dam was the largest and tallest ever built up to that time. It is 730 feet high, 650 feet thick at its base, 1,180 feet wide at the top, and contains 3,500,000 cubic yards of concrete. Lake Mead, the reservoir formed by the dam, is 115 miles long, eight miles wide at its widest point, and has storage capacity of 30,500,000 acre-feet of water.

The tremendous heat generated by the hydration of cement is one of the problems encountered in the pouring of massive concrete structures. To solve this problem at Hoover Dam, 662 miles of steel pipe were embedded in the concrete as it was poured, and refrigerated water was circulated through this pipe to cool the concrete. Building the dam in small blocks and waiting for atmospheric cooling, in order to prevent formation of cracks, would have required 125 years.

Before construction could start on the dam, roads had to be built; a town — Boulder City, Nevada — located and built to house the workers and provide offices; a spur rail-line built out from Las Vegas, Nevada; four large diversion tunnels bored to carry the water while construction was underway; coffer dams constructed; the site cleared of all rubble and loose rock; and the foundation and walls grouted. The contract price for the dam and the construction of a building to house the generating units was just above \$50,000,000, but changes and extras ran the cost above this figure.

The prevention of floods and the storage and control of irrigation water was not enough to justify the cost of building such a monumental structure. Hydroelectric power had to be developed, not only to fill a need for power, but also to pay the major portion of the cost of construction. To supply such power, fifteen generating units of 115,000 H. P. each, and two 55,000 H. P. units were installed. Contracts for the purchase of this power were signed before the generators were installed. Most of this power goes to California, but Arizona gets a certain portion. It is estimated that the sale of this power will, by 1985, pay the \$108,800,000 total cost of construction and generators, as well as the accumulated interest of \$11,200,000.

To complete the control of the river, it was

necessary to construct a diversion dam and desilting works above the now inadequate Laguna Dam on the lower section of the river. Provision for this was made in the Boulder Canyon Project. Construction of the Imperial Dam and desilting basin was started in 1936. This dam, located about eighteen miles north of Yuma, is of the slab and buttress type, supported and anchored by long concrete piles. It is forty-five feet high, 3,430 feet long, and equipped with roller and radial gates for control of water discharge. Its main purpose is diversion of water into the old Imperial Canal, part of which is in Mexico, into the new All-American Canal, and the Gila Canal on the Arizona side of the river. However, it also acts as a storage dam for the drainage area between it and Parker Dam, the next storage dam upstream. The desilting works consist of three basins 500 by 800 feet, in which the heavy silt load of the water can be removed, thus saving the large annual cost of removing silt from the canals. It is estimated that the entire cost of the desilting works, \$1,500,000, will be saved in two years. These works were not put into operation for several years after the All-American Canal was constructed as some silt was needed to seal the sandy bottom and sides of this canal. The original contract for the construction of the Imperial Dam and desilting works was \$4,374,240. All of this was a part of the Boulder Project.

Other Dams on the Lower Colorado. Parker Dam, with its power plant, is located about twelve miles above Parker, Arizona, and just below the confluence of the Bill Williams River with the Colorado. It was constructed in 1937–41, primarily to serve the needs of the Metropolitan Water District for domestic and commercial water and power. The five southern California counties which form this district in 1931 voted an issue of \$220,000,000 for the construction of this dam, power plant, and an aqueduct to carry the water to the District. This dam is unusual because of the fact that an excavation 235 feet below the stream bed had to be made to reach a satisfactory foundation. This makes it the deepest dam in the world. Its power plant has a capacity of 120,000 kilowatts. About half this power is necessary to lift the water in the aqueducts over the summits which had to be transversed to reach the West Coast area. Lake Havasu, formed by the dam, has an area of thirty-nine square miles and a capacity of 619,000 acre feet.

Davis Dam was constructed in Pyramid Canyon,



— U.S. Bureau of Reclamation

Davis Dam and power plant, downstream from Hoover Dam

which is eighty-eight miles upstream from Parker Dam and sixty-seven miles downstream from Hoover. It is an earth and rock fill embankment with concrete spillway, intake structure, and power house. It forms the long and narrow Lake Mohave, which has an area of forty-five square miles and a storage capacity of 1,818,300 acre-feet. This lake, like Mead and Havasu, is important as a recreation and fish and wildlife preserve. The power plant has a capacity of 225,000 kilowatts. Built by the Bureau of Reclamation at a cost of \$67,000,000 for dam and power plant, Davis Dam acts as a forebay for the

control of water made available for irrigation of lands in Mexico, in accordance with the United States treaty with that country in 1945. The cost of this facility eventually will be paid for by the sale of power developed at the dam.

Also on the lower Colorado is Headgate Rock Dam, a diversion dam located just below the town of Parker, Arizona, for the purpose of diverting water for the irrigation of about 37,900 acres of land on the Arizona side of the river in the Colorado River Indian Reservation. Another diversion dam, Palo Verde, located just north of Blythe, California,



— U.S. Bureau of Reclamation

Looking downstream at the construction of the Glen Canyon Dam and Bridge

diverts water for the irrigation of 72,000 acres of California land in the vicinity of Blythe. Below the Mexican border, Morelos Dam diverts water for irrigation of Mexican farm land.

The Glen Canyon Dam Project. Upstream from the Grand Canyon, another control dam now under construction is Glen Canyon Dam. This monumental structure is being built just inside Arizona's northern boundary. Since it is above Lees Ferry, the division point of the Colorado Compact, this dam is actually a creature of the upper basin states. At present, Arizona has no commitment for any of the power which it will generate, although the public and private utilities of Arizona have jointly offered to contract for the dam's entire power output. The dam will be a concrete arch, 700 feet high and 1,500 feet long, and will form a lake 254 square miles in area, with a storage capacity of 28,040,000 acre-feet. This reservoir will slow down the silting of Lake Mead behind Hoover Dam.

To provide for the construction of Glen Canyon Dam, an entire new community, Page, has been

founded on the Arizona side. This dam has already had an important effect on the economy of northern Arizona, for, in addition to the location of the railroad at Flagstaff, the town of Clarkdale has been rejuvenated by the erection of a cement plant there to supply the material for the construction of Glen Canyon Dam. Moreover, a new road has been constructed across a hitherto inaccessible area of northeastern Arizona, with a bridge which crosses at the dam, opening to tourists an area of fantastic beauty, and bringing to the Navajo Indians of this remote area the perils and delights of civilization.

The Arizona-California Controversy. The presently irrigated lands along the Colorado River have an ample water supply from storage in Lake Mead. However, title to most of the waters now wasted into the Gulf of California lies in the upper Colorado River basin states. Further increases in irrigation use of Colorado River water in Arizona are dependent upon the final outcome of the case over water rights between Arizona and California which is now before the Supreme Court of the United States.

Arizona's right to use additional water from the Colorado has been a subject of controversy for almost forty years. The argument with California is due to the fact that there is not enough water in the river to meet the continually increasing needs of both states, particularly during years of low flow. The Colorado Compact of 1922 allocated 7,500,000 acre-feet of water to the three lower basin states. Under the terms of the Boulder Canyon Project Act, limitations of 4,400,000 acre-feet were set for California, 2,800,000 for Arizona, and 300,000 for Nevada, and California was required to enact legislation limiting itself to the stipulated 4,400,000 acre-feet. However, Arizona and California have never agreed on the interpretation of the division.

California claims that the 2,800,000 acre-feet assigned to Arizona should include the waters of the Gila River, a tributary which lies almost wholly in Arizona, joining the Colorado near its mouth, and whose waters have been put to beneficial consumptive use by Arizona citizens for many years. Arizona contends that it should have 2,800,000 acre-feet from the main stream of the Colorado, and that the waters of the Gila should in no way be included in this figure. California further claims that due to prior right of beneficial consumptive use, any losses due to evaporation or lack of sufficient supply during years of drought should not affect its entitlement to 4,400,000 acre-feet, whereas Arizona contends that any shortage should be suffered on a pro rata basis.

During the years of controversy, developments on the Colorado, instigated mainly by California, have proceeded. These include the dams, hydro-electric projects, and canals of the lower Colorado which were discussed above. However, California has also been diverting annually nearly 1,000,000 acre-feet in excess of the 4,400,000 allocated to it.

In an attempt to halt California's diversion of this water in excess of the limitation, and in hopes of settling the interpretation of allocations, Arizona filed suit against California in the United States Supreme Court. The Court appointed a Special Master to hear the testimony and make recommendations to the Court. Over a period of about five years the Special Master listened to 106 witnesses whose testimony covered 22,000 pages, read 3,472 pages of depositions, and, of course, listened to interminable arguments by attorneys assigned to the case by the litigants. On May 8, 1960, Special Master Simon Rifkind's preliminary report was made public. His findings, briefly, are as follows:

1. The decree upholds Arizona's definition of consumptive use, e.g., diversion less return flow.
2. Waters of the mainstream below Lake Mead are divided, and the Gila and all other tributaries below Lake Mead are excluded.
3. The Mexican Treaty obligation of 1,500,000 acre-feet annually gets first call. This sum will be borne by the lower basin, but, when the surplus above 7,500,000 is insufficient to meet this draft, the upper basin will be called upon to share the deficiency on a 50-50 basis.
4. The decision grants Arizona 2,800,000 acre-feet annually, and Nevada 300,000, and limits California to 4,400,000 acre-feet, or nearly 1,000,000 less than it is now diverting from the main stream.
5. Water in excess of 7,500,000 acre-feet and the treaty obligation of 1,500,000 acre-feet will be divided equally between Arizona and California.
6. If Nevada signs a contract with the federal government to develop an irrigation project, it will share in any surplus water to the extent of 4 percent, which would reduce Arizona's share of the surplus to 46 percent.
7. If the flow below Lake Mead is insufficient to meet allocations, the water will be divided on the same percentage basis as allocated: Arizona will get 38/75ths; California 44/75ths; and Nevada 3/75ths.
8. Prior rights of Indian tribes will be scrupulously observed.

It should be noted that the decision does not follow the rule of prior appropriation and use of water, which has been the water law in many western states. However, the recommendations are most favorable to Arizona and substantiate almost entirely the claims which this state has been attempting to establish over the last forty years.

Judge Rifkind's action, however, is not final. Litigants may still present arguments to the Special Master, and these will be considered before he makes his final recommendation to the Court. After this has been done, attorneys will have an opportunity to present final arguments before the Court. It is rare that the Court reverses the findings of a Special Master but it may do so since it is not bound by his recommendations.

Arizona now looks forward most hopefully for a final decision of the Supreme Court which will confirm the recommendations of the Special Master and thus assure Arizona of ample water not only for its vast agricultural enterprises but also for its continuing municipal and industrial expansion.

. *soils*

SOME OF THE MOST PRODUCTIVE SOILS IN THE world are located in Arizona. The combination of climate and fertile soils has placed Arizona at the top of the list in crop yield on a per acre basis. Arizona leads the nation in average yield of cotton per acre, and is at the top in alfalfa and barley yields. The rich store of plant nutrients in Arizona soils contributes greatly to this production. Most soils are fairly well supplied with native phosphate. A small portion of this has been found to be in the organic form. However, not all of the native soil phosphorus is available for plant use. Calcium has been found to be united with the soil phosphates to form slowly soluble forms. Because of the intensive cropping system and long growing season, certain crops produce better with addition of phosphate fertilizer. Yield response is variable, however, depending considerably upon soil type and kind of crop. The soils of Arizona appear to be well-supplied with available potassium. Micronutrients usually are present in abundance. Deficiencies in available iron, however, require attention in some soils. Supplemental zinc also appears to be required in certain soils, particularly when citrus and nut trees are grown. Nitrogen is the most limiting plant nutrient. This element must be added to soils to obtain high-crop production.

The soils of Arizona vary widely in response to variations in four major soil-formation factors: climate, parent rock material, relief, and vegetation.

The climate in Arizona ranges from arid to sub-humid. Great temperature and precipitation differences, caused by the rapid changes in elevation over short distances, combine to play an important role in the formation of a host of different soil types.

The parent rock material from which soils are formed also varies considerably within short distances, often in response to abrupt change in elevation. Geological materials of Arizona are characterized by the presence of many types of rocks. The volcanic rocks include acid igneous, basic igneous, cinders, ash, and tuff. The sedimentary rocks include a wide variety of limestone, sandstones, siltstones, shales, claystones, and conglomerates of different geologic ages and physical and chemical characteristics. Many types of acid igneous rocks are distributed in the area and a variety of metamorphic rocks are found. These rocks also occur in various proportions in different alluvial deposits.

The more common types of physiography are desert floors or flats, undulating to gently rolling plains, nearly level to moderately sloping alluvial fans and basins, valley plains, dissected rolling plateaus, moderate to steep hills, mountain footslopes, and steep mountains.

Time markedly influences soil characteristics in Arizona. Some soils indicate that they weathered under a different climate than that of today. Such soils are old on the basis of both time and maturity. At the other extreme is the very young alluvial soil which shows little or no influence of weathering.

In certain parts of the region there is a complex pattern of soil series as a result of sharp changes in terrain. In such cases each soil series may occupy only a small acreage. Although considerable progress is being made in classifying soils of Arizona into series and higher categories, the classification is as yet incomplete.

About 2 percent of the land in the Southwest is

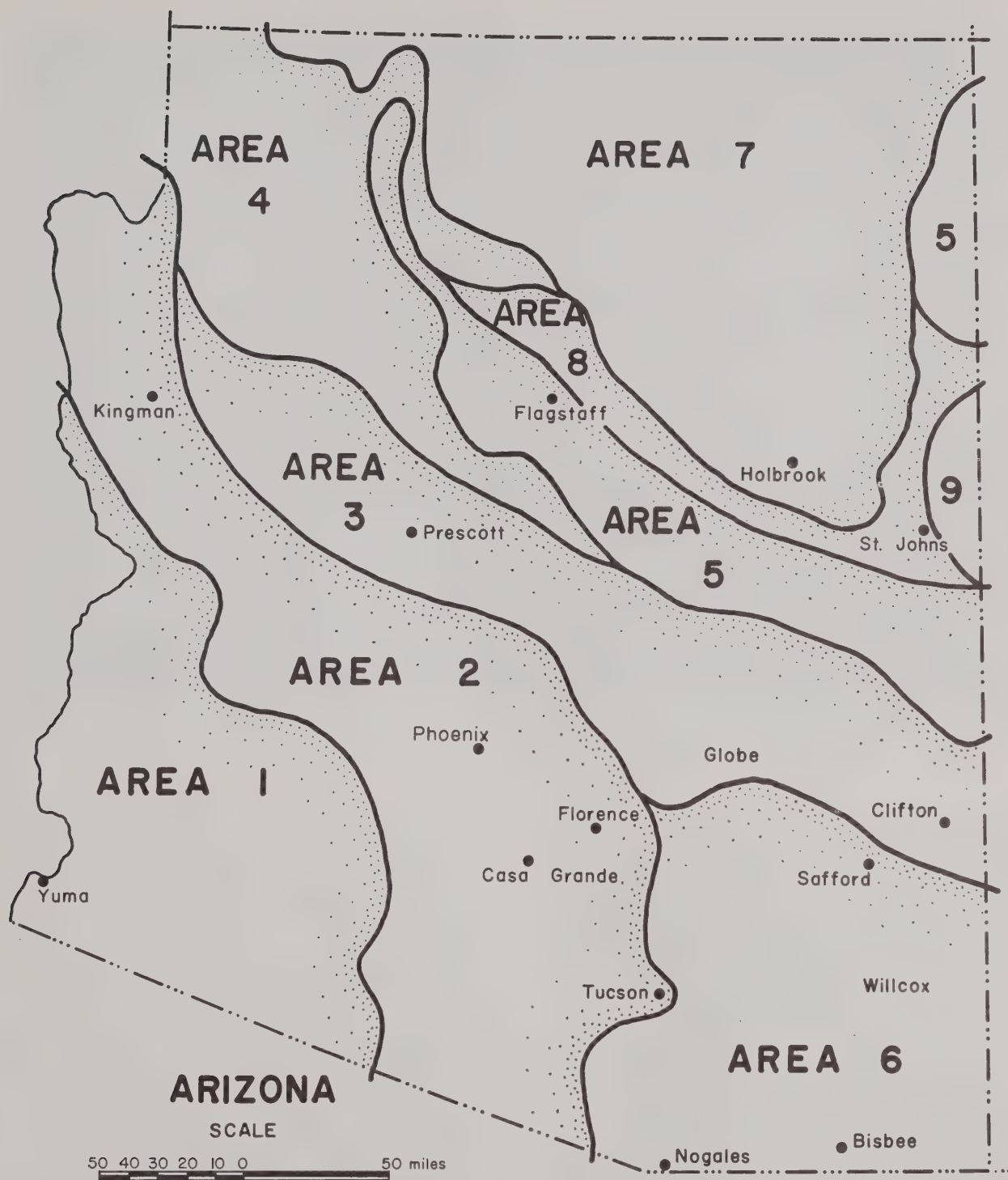


Fig. 1. Map of Great Soil Groups showing nine areas of association in Arizona

under cultivation. The bulk of this area is irrigated, the remainder being dry-farmed. Most of the soil survey work in Arizona has been concentrated on

the cultivated soils. Soil classification has progressed only to a limited extent on the range and forest lands. Recently, however, there has been an increasing



— Esther Henderson

Productive soils and light rainfall furnish rangeland for grazing Arizona livestock

interest in an intensive classification of range and forest soils.

Arizona soils are most often described as being alkaline in reaction, limy, salty, and low in organic matter. Although this does not fully describe all the soils of Arizona, the land areas that are in high demand for crop production, industry, and the development of municipalities do have some of these characteristics. The great land areas of the hill and mountain provinces generally are more highly leached and support a denser vegetation. Certain soluble salts and lime accumulations are found within the root zone of plants in the valley floors under the arid and semiarid climatic condition where irrigated agriculture flourishes. The lime occurs as nodules, mottlings, or layers ranging in thickness from a few millimeters to several feet. This lime accumulation is called "caliche."

Soils in Arizona, for the most part, have not developed sharp or distinct profile characteristics as have the soils of more humid areas. Those in narrow

valleys as well as those of steep mountains and mountain footslopes appear to be little more developed than they were when deposited by stream action. They are often characterized as stratified gravel, sand, silt, or clay materials with rocks prevalent on the footslopes.

Soils of Arizona are characteristically low in organic matter and therefore in reserve nitrogen. Under continuous cropping this reserve often has been further depleted. No other plant nutrient is as universally required by the soil to support the present demand of high crop yields as is nitrogen. The recognition of the importance of nitrogen has created a large commercial fertilizer industry in Arizona. Commercial nitrogen now occupies a key position in Arizona agricultural production. Crop production level is closely related to the quantity of nitrogen supplied. More than 180,000 tons of nitrogen or nitrogen-carrying fertilizer were used in Arizona during 1958. Among the various sources used were ammonium sulfate, 29,000 tons; ammonia (anhy-



— Esther Henderson

Cotton flourishes on the cropland soils that nourish Arizona's irrigation farming

drous), 20,000 tons; urea, 13,000 tons; calcium nitrate, 13,000 tons; ammonia solutions (20-0-0), 11,000 tons; and ammonium nitrate, 10,000 tons. Included in the nitrogen-carrying materials are 67,-391 tons of mixed fertilizers containing one or more of the above forms of nitrogen. Important quantities of ammonia, ammonium nitrate solutions, calcium cyanamid, sodium nitrate, and liquid nitrogen fertilizers also are applied annually. Nitrogen of all sources must be used in the most efficient manner if the high level of production in Arizona is to be sustained.

In order to utilize this rich natural soil resource to the greatest extent, careful attention must be given to soil and water management practices. Great rewards come from the soil to those who follow the well-established rules of soil and water management.

The great soil resources of Arizona are only partly utilized. Large areas of potentially highly productive land are still in their virgin state. These areas depend upon the availability of water for their

development. The estimated area of land in Arizona suitable for cultivation, if water were available, is reported to be about eight and one-half million acres. The present acreage now in irrigation is about one and one-quarter million acres. About four million acres of the arable land are excellent in quality and sufficiently level to permit them to be put into production with very little treatment. Class III land, which has been estimated at about two and one-third million acres, will require some leveling before irrigation can be applied properly. Class IV land, which has been estimated at two million acres, will not lend itself well to flood irrigation but could be irrigated by the sprinkler system.

The association of Great Soil Groups is considered to be a logical generalization for the purpose of preparing broad soil maps of Arizona. The miscellaneous land classification of Rock Land is included in the association, although not as a Great Soil Group. The significant amount of this miscellaneous type warrants its use in the association. Figure 1

shows the nine different associations of Great Soil Groups that occur in Arizona.

Calcisol-Alluvial-Rock land association, *Area 1*, occurs in the extremely hot and dry lower Colorado River basin. The low annual rainfall of 3 to 6 inches and the high prevailing temperatures are not conducive to the complete removal of lime from the surface soil. Consequently, there is an accumulation of lime throughout the soil profile. Calcisols form on highly calcareous or limy parent material. They develop where leaching is limited and under a vegetation of short grass and shrub. The surface soil is light gray to grayish brown and becomes slightly darker with depth until free lime, characteristic of caliche, appears. This lower zone is light gray and often gravelly. Usually the limy zone is underlain with coarse gravel and stones. Very few Red Desert soils are found in this area. Chemical weathering is limited in soils of this association. The soils of this association are highly productive and are of great economic importance to Arizona.

The Red Desert-Calcisol-Rock land association, *Area 2*, occurs in the desert of southwest Arizona. The rainfall which ranges between six and seven inches annually has either been effective in removing lime from the upper part of the solum or has maintained the condition that developed under a previous wetter climate. Red Desert soils are the only significant zonal soils that occur within this area. They derive their name from their surface color which ranges from light pinkish-gray to reddish brown or red. The upper subsoil often is a deeper red than the surface and is compact. The lower subsoil is pink to light gray, rich in lime and mineral nutrients. When irrigated these soils are highly productive. Calcisols are of widespread occurrence and Rock land predominates in the small scattered mountain ranges of this area. The alluvial soils of the valley floors are economically important because of their intensive agricultural use. They are among the most productive soils in the world when irrigated.

The Reddish Brown-Grumusol-Lithosol association, *Area 3*, may be more appropriately considered a complex of Great Soil Groups because of the intricate pattern of soils. This area forms a transition zone between the Sonoran Desert and the high Colorado Plateau. It is extremely variable as to parent material, vegetation, topography, and climate. Lack of soil surveys in the area precludes an accurate appraisal of Great Soil Groups which constitute the predominant association. The Reddish Brown soils

are the most abundant zonal soils. These soils have a reddish brown to red surface color and a mellow consistency. The lower subsoils are pink, or white and very limy. These soils appear under short grass vegetation at elevations above the lower valleys. They have a high inherent fertility. Most of this area is in livestock, ranches, and public ranges. Small areas of Reddish Brunizem, Reddish Chestnut, and Brunizems also are included in *Area 3*. Grumusols are scattered throughout the association where basic igneous rock occurs. Grumusols are reddish-brown or brown clay soils weathered on volcanic rocks. Because of the high clay content of an expanding lattice type, the soils shrink severely during the dry season and swell upon wetting during the rainy season. The soils have the unique property of churning, to a depth of twenty to forty-eight inches. This phenomenon is the result of soil granules sloughing down the shrinkage cracks. When rains occur, water fills the cracks first causing expansion in the vicinity of the crack. Strong pressures develop which extend the expansion in a lateral direction. This sequence of forces results in a churning, or turning motion of the whole soil mass. The soils are fertile and contain no appreciable soluble salts or alkali. A few lime nodules are found throughout the profile and a weak to moderate lime horizon appears immediately above the bedrock. The surface is hummocky or somewhat undulating. Because of the relatively steep slopes and extent of consolidated rocks in much of this area, Lithosols also are common. These soils are noted for their shallow depth and lack of profile development. Other Great Soil Groups that occur are Noncalcic Brown and Alluvial.

The Gray Desert Sierozem-Reddish Brown Association, *Area 4*, occurs on the western edge of the Colorado Plateau in Northern Arizona. The topography is gently to moderately rolling with scattered hills and mountains. Canyons and escarpments are common. The Gray Desert Sierozem soils are considered as the counterpart of the Red Desert soils because they are formed under like circumstances, but under cold temperature rather than hot temperature conditions. They are found under a vegetation of desert shrubs. The surface soils are light grayish-brown to gray and low in organic matter. The subsoils are lighter in color and limy. They are slightly leached. Small areas are found to be salty. In general, however, the Gray Deserts are very fertile and productive when irrigated. Other Great Soil Groups that occur in significantly large bodies are Grumusols,

Lithosols, and Regosols. Rock land is extensive in the area of escarpments, canyons, and mountains.

Area 5 includes the most mountainous physiography of the Southwest. No particular soil association is given because information concerning the areas is still too limited to permit naming an association with accuracy.

The pattern of Great Soil Groups is quite irregular. The recognized important Groups are Reddish Chestnut, Reddish Brown, Lithosols, Brumusols, Reddish Brunizem, Grey Wooded, Planosols, and western Brown Forest. It is logical to expect other Great Soils Groups to occur in the area, especially in the high mountain regions.

The Reddish-Brown-Calciisol-Red-Desert Association, *Area 6*, occurs in southeastern Arizona. Most of the area has a semiarid climate or an arid climate in the lower elevation. Several mountain ranges, although small, add to the complexity of the soil pattern. Information on the soils in the mountain area is limited because of the lack of soil surveys. The topographic features include sloping, and gently to moderately rolling valley basins, hills, and mountains. A few of the basins have closed drainages with intermittent lakes or playas. In addition to the Great Soil Groups mentioned, this area also includes representatives of the Reddish Chestnut, Solonetz, and Lithosols. Miscellaneous land types include Rock Land, Sand and Gypsum dunes.

The Gray Desert-Calciisol-Lithosol Association, *Area 7*, occurs on the Colorado Plateau in North-

eastern Arizona. This is the highest portion of the plateau. Most of the area lies at an elevation between 5,000 and 7,000 feet. Additional Great Soil Groups included are Alluvial soils and small areas of Reddish Brown soils. Miscellaneous land types that occur are Rock Land, Sand Dunes, and "Badlands" or "Painted Desert." Although the topography is neither hilly or mountainous, it appears so because of many escarpments, breaks, mesas, buttes, and canyons.

The Reddish Brown-Calciisol Association, *Area 8*, includes a large area and is located south and southeast of the Grey Desert-Calciisol-Lithosol Association. The most important differences are related to increased rainfall and higher mean annual temperature. In the Reddish-Brown-Calciisol Association these differences, although not great, have significant effects on soil formation. The color of the subsoil is red, and lime has been moved to a greater depth in the solum where it accumulates in the lower subsoil. Other Great Soil Groups are the Reddish Chestnut and Lithosols.

The Reddish Chestnut-Reddish Brown Association, *Area 9*, is located on the southeastern portion of the Colorado Plateau. The topography includes nearly-level to rolling plains, with hills, mountains, escarpments, and mesas. Juniper and grass vegetation predominates. Other Great Soil Groups which occur in this area include Reddish Brunizem, Grumusols, Lithosols, and Alluvial soils. Small areas of Rock Land appear throughout the area.

..... *minerals and fuels*

ARIZONA IS PARTICULARLY WELL ENDOWED WITH metallic and non-metallic minerals. Scientific and technological advances, as well as improvements in transportation during the past 100 years, have augmented discovery and development of these metal resources. The discovery rate of the last decade has been outstanding, and a brilliant future for discovery is anticipated.

Metal resources of Arizona are varied. The important ones are copper, zinc, uranium-vanadium, gold, silver, manganese, molybdenum, and lead. Others which are noteworthy are tungsten, iron, titanium, and mercury. Minerals of many other metals are found in Arizona, but these are not recognized as resources, judging from present knowledge of their occurrences and from predictable economics.

Metallic Ores

DISTRIBUTION OF METAL DEPOSITS. Distribution of significant metallic mineral deposits is shown on Figure 1. This map presents a "miner's view" of Arizona's metal resources. Generally, only the most important deposits are shown for each mineral known to be present in significant concentrations and quantities. Past production and future potential are the bases for selection of districts and deposits. Both known and potential deposits of some selected areas are not considered as economic under present conditions. However, these deposits will become economically profitable with minor favorable changes of present conditions — technological, economic, and/or political.

Metal deposits have been divided into two main types in Figure 1: copper-zinc-lead and other types.

Deposits of copper, zinc, and lead are considered as one type. Ore bodies of any one of these three metals either contain significant amounts of one or both of the other two, or they are found in very close proximity to ore bodies of one of the other metals.

For the past fifty years, Arizona has been the leading copper-producing state. Its relative position is increasing, and the state now produces more copper than all other states combined. During the last twenty years, Arizona has lost some of its large copper mines by depletion of reserves. However, record discovery and development rates, during the last decade, have more than replaced these losses.

The important copper resources are in the Mountain and Basin and Range provinces of the state. Outside the important districts, copper deposits are widely scattered over these areas of the state. Further rather numerous, but less significant, deposits are scattered over the portion of the state that is within the Colorado Plateau province.

Copper is found in all four corners, along all boundaries, and in central portions — in basins and ranges, in the highest plateaus, in the deepest canyons — across the face of Arizona.

GENESIS. Southern and southwestern Arizona comprise a metal province of major importance mainly because the province is one of extensive and complex igneous activity. The major activities were during the Precambrian era and the Tertiary period although activity in other periods is recognized.

The periods of igneous activity were the results of fracturing, broad-scale shattering, displacement, and deformation of rocks, caused by enormous differential stresses in the crust of the earth. The molten

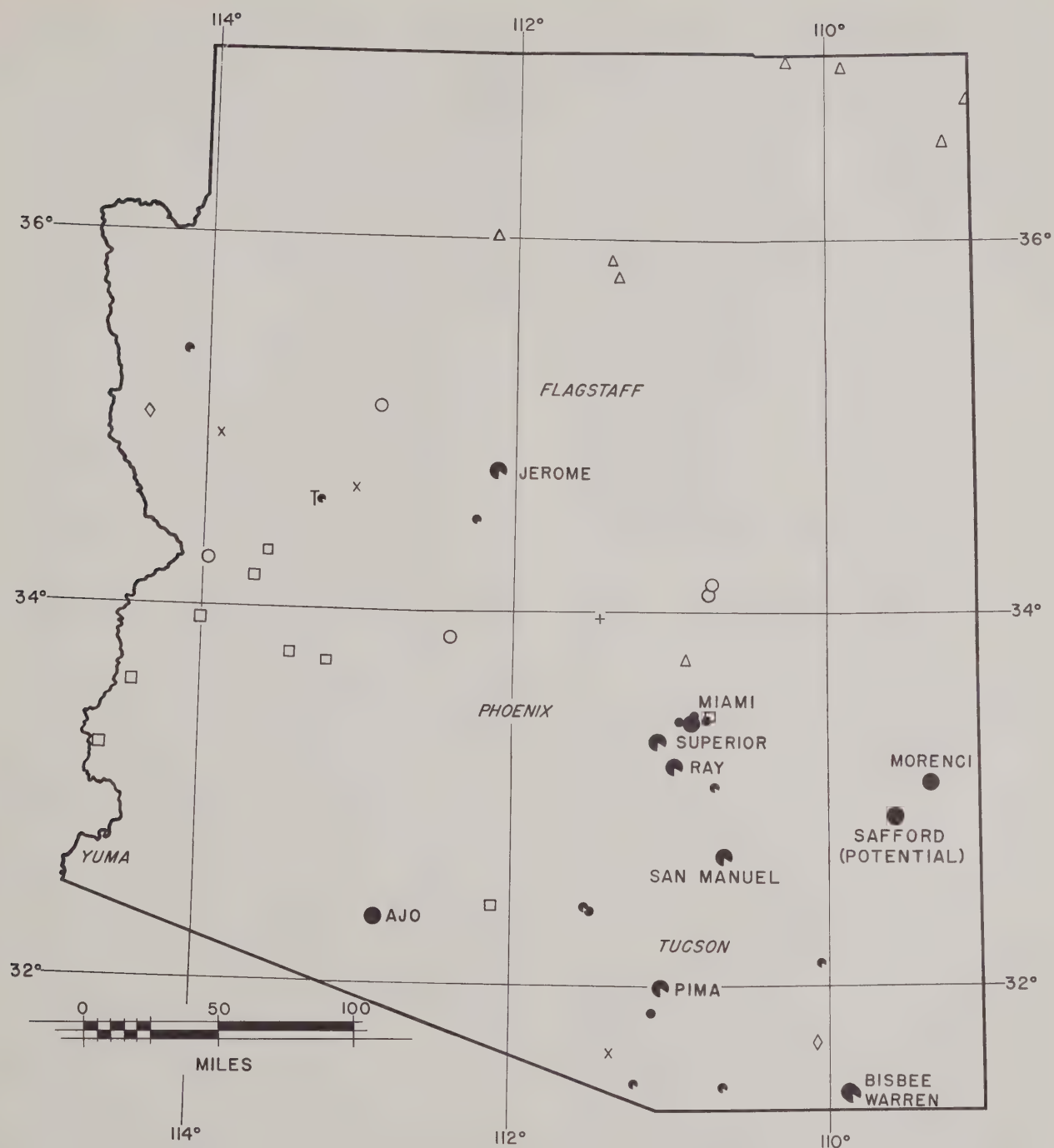


Fig. 1. Significant metallic mineral deposits

● Major copper districts (named)

• Important copper districts

(Important zinc and lead deposits
indicated by blank sectors in symbols)

△ Uranium-Vanadium

□ Manganese

◇ Gold, Silver

× Tungsten

○ Iron

T Titanium-Iron

+ Mercury

igneous rocks filled "gapping" openings (resulting in intrusions) and flowed out on old surfaces in the form of extensive lava flows. These events occurred repeatedly in many localities.

Metal-bearing hot solutions separated from cooling intrusions, and most of Arizona's metal-bearing (ore) deposits were emplaced originally in fractured rocks by these solutions. In the case of many deposits, the metal-bearing solutions dissolved rock-forming minerals in the vicinity of fractures and replaced them with metallic minerals. Later weathering and erosion have caused some change in the characteristics of the original ore deposits.

THE SEARCH FOR UNKNOWN ORE DEPOSITS. A heritage from great crustal forces across the face of Arizona and to the depths of the earth, the southern and western part of the state is the nation's best copper province. It is the hub of America's copper exploration effort today. Arizona, past and present, has attracted a large percentage of the best mining geologists in the world. This, too, is Arizona's heritage.

Many major metal mining companies, as well as a number of small organizations, have exploration offices in Arizona. The discovery record demonstrates that, on the average, these exploration efforts are successful. However, the risks are high, and many expensive efforts go for years with no reward. Hidden wealth is not easily won from Arizona's rugged face. Scarred and wrinkled in antiquity, it presents complex puzzles. Some organizations spend millions of dollars, only to be forced into retreat empty-handed. Others receive smiles of fortune from the rugged face, reaping fabulous rewards. Many discoveries are made annually near known ore bodies, and occasionally discoveries are made in isolated areas.

The challenging problems to be solved occupy the attention of both prospectors and geologists, and not only practicing mining geologists but geological scientists, such as those of the U.S. Geological Survey and of the University of Arizona. The most basic problems are reconstruction of geologic events and the relative timing of those events.

AGE OF METAL DEPOSITS. The age of metal deposits in the state has been the focus of much attention by geologists. While the ages of some deposits are fairly well established, the ages of the majority of deposits are matters of geologic speculation, based on indirect evidence. Much research is needed to solve problems of time relationships.

Age classification is attempted here subject to the above qualifications. Arizona metal deposits can be classified, in time of formation, as follows: Precambrian, Jurassic, Laramide, late Tertiary, and Quaternary. The first three categories are of major importance. Laramide, a period of widespread rock deformation and mineralization in the western states, is approximately equivalent to early Tertiary in Arizona.

Metals deposited in Arizona during Precambrian time are copper, gold, silver, zinc, lead, tungsten, titanium, iron, and possibly mercury and molybdenum. The most important known Precambrian deposits are those located at Jerome (copper, gold, silver, zinc) and Humboldt (zinc, lead, gold, silver, copper) in Yavapai County. Most of the Precambrian deposits are in Yavapai County. One important exception is the iron deposits near the Mogollon Rim in Gila and Navajo counties.

The only metal deposits which are assigned approximately to the Jurassic period are some of those in Cochise County, the major Bisbee-Warren district being the only district clearly in this category. Metals of these deposits are copper, zinc, gold, silver, lead, and manganese.

Most of the important metal deposits in Arizona were deposited during Laramide time. The majority of these important deposits are copper-gold-silver, zinc-lead-copper-gold-silver, or combinations of the two types. Copper deposits are, by far, the most important, and these provide the main source of molybdenum. Ores from these deposits commonly contain more iron than copper, zinc, or lead, and this is also true of the Jerome ores. The iron, in the form of sulfides, is not presently used in making steel, but it is an important resource. All of the significant uranium and vanadium deposits of Arizona are probably Laramide, as are many of the gold-vein deposits. Some of these manganese deposits also originated during this time. Iron deposits in northern Yavapai County are probably Laramide, and the numerous, small copper deposits scattered over the Colorado Plateau also are probably placed in this category.

The only important metal deposits assigned to late Tertiary are those of manganese, such as those of the Artillery Peaks area. Some minor concentrations of uranium were formed in Tertiary alluvial beds during late Tertiary time.

Many older metal deposits were considerably altered by weathering during late Tertiary and during

Quaternary times. Arizona's semi-arid climate was much the same then as it is now. Under such conditions, copper deposits tend to become enriched by primary copper deposits concentrating into smaller deposits of greater copper content per unit volume. This process has been so important in Arizona that the state's high status as a copper producer can be attributed, in part, to its climate. The soluble copper salts, resulting from weathering, were moved by groundwater, not only causing enrichment but, in some cases, forming new copper deposits. Such deposits, as some of those north of Miami, can be dated as late Tertiary or early Quaternary.

With the possible exception of the secondary copper deposits described above, Quaternary metal deposits are mainly limited to gold placers (gold in sand and gravel of washes). The placers are scattered over the southern and western portions of Arizona. **THE PORPHYRY-COPPER STORY.** Copper, the red metal, is an important part of Arizona's history. Major, high-grade ore bodies have been discovered and mined at Bisbee, Jerome, Globe, Superior, and Morenci. These ore bodies are of various shapes and forms, such as those called "oreshoots" (in veins) and "blankets," and they are often found in close proximity, occurring in clusters — chests of hidden treasure, million-dollar jewel boxes. Copper in Arizona is not limited to high-grade ore bodies, however. It is found as large low-grade disseminations, seemingly "soaked" into large masses of rock. Copper minerals of such deposits are both intergranular with the rocks itself and in small cavities or veinlets.

Copper deposits of large volume but small copper content per unit volume comprise a type generally known as "porphyry-copper deposits." A porphyry is a fine-grained igneous rock with scattered larger grains. The name is applied to this type of copper deposit because the type is commonly associated with porphyries.

The southern and southwestern section of Arizona is a classical locality for porphyry coppers, and most of the porphyry-copper deposits of the world are found here. The important known porphyry coppers of Arizona are Miami, Inspiration, Castle Dome, Copper Cities (all in the Miami district), and Morenci, Ajo, Ray, San Manuel, Bisbee, Silver Bell, Bagdad, and Esperanza. The major Mission and Pima deposits of the Pima district, south of Tucson, could also be added to the list, although technical reasons can be cited as to why these should

not be classified as porphyry coppers. Including these, a total of fourteen Arizona porphyry coppers are listed.

Probably, most of the sparkling jewel boxes have been found and opened — the contents exploited. Arizona's elevated copper position today is not dependent on rich, high-grade ore bodies, which, by Nature's balance of justice, are relatively small. The position is based, instead, on the large to enormous low-grade ore bodies — the porphyry coppers.

With most disciplines, the slowly expanding frontiers of knowledge are marked, on rare occasions, by major breakthroughs — mileposts of man's efforts to rise above his abysmal ignorance. One of the main mileposts in the mineral-exploration area of knowledge applies directly to porphyry coppers. The subject is the interpretation of leached outcrops.

The two men who led the leached outcrop effort, who were most responsible for the breakthrough, were both commercial mining geologists and scientists as well. Combined with the incentive of the prospector was the scientific inspiration of the knowledge frontier. These men are Augustus Locke and Roland Blanchard.

An outcrop is the surface exposure of a rock or mineral body. Weathering, at and near the surface, often causes changes in the minerals comprising rocks or mineral deposits. In the case of copper deposits, the copper sulfide minerals, as originally deposited, are oxidized, and resulting copper salts are often carried into solution, usually downward as rain waters seep into the ground. Thus, copper values are often removed from the out-cropping or upper portions of copper deposits.

Through the weathering process, the exposed, outcropping portions of copper deposits can be essentially barren of copper. The extracted copper values would percolate downward to the water table, being dispersed and lost. However, under the correct conditions of geology and climate, the dissolved copper values are not altogether lost. Below the water table, sulfide minerals are protected from oxidation by water saturation, and there, in the absence of free oxygen, copper tends to be precipitated from solution. Thus, at the water table, the copper content of the deposit tends to increase, being built-up by values swept from above. The copper is precipitated from solution in the form of chalcocite, a sulfide of copper.

Through the process of oxidation, solution, and precipitation, an enriched zone is formed at the water

table. This zone is called a "chalcocite blanket," although such a blanket is not always present. Whether or not a chalcocite blanket can be found, below a given outcrop, depends on many factors. Some of these are recognition and interpretation of the leached outcrop, original alteration of the mineralized ground and its original mineral content, conditions of geologic structure, geologic history, and paleoclimate. The copper content of some porphyry coppers was sufficiently high, before subjection to the weathering process, so that a chalcocite blanket is not needed to make the deposit economic. However, without a chalcocite blanket, the copper content of many porphyry-copper deposits would be too low for economic interest.

A unique set of favorable conditions forms the ideal environment for a porphyry-copper deposit. Igneous history should be intense and complex, and breccia pipes should occur in the vicinity. The water table should be deep for a prolonged period, and erosion should be deep and slow.

Rates of erosion and weathering should be in approximate balance, the rate of weathering slightly exceeding that of erosion. Rocks in the immediate vicinity should be non-reactive to acid solutions. The right combinations of these and other conditions are likely to be found in the southern and southwestern section of Arizona. For example, the antiquity of its present semi-arid climate is favorable to the weathering, erosion, and water-table conditions expressed above.

All of Arizona's porphyry-copper mines which were in operation in the 1930's were among the "laboratories" used in leached-outcrop studies. The leached-outcrop concepts, which are summarized in a classical paper by Blanchard, have given us much more than simply the ability to recognize and interpret porphyry-copper outcrops. They have given us understanding of the porphyry copper and its genetic processes. With this knowledge, the porphyry copper is discovered, developed, and exploited more intelligently and more economically.

Of the fourteen Arizona porphyry coppers, nine have been discovered and/or developed since the full development of the leached-outcrop concepts. Also, much additional ore has been discovered at old porphyry-copper mines since that time. In order of magnitude, the value of these newly developed ore bodies is at least a few billions of dollars. The impact of these concepts on Arizona — the role that the concepts have played in most of the new



Fig. 2. Principal areas of volcanic industrial rocks (stippled) and potential Tertiary lake bed accumulations (crosshatched)

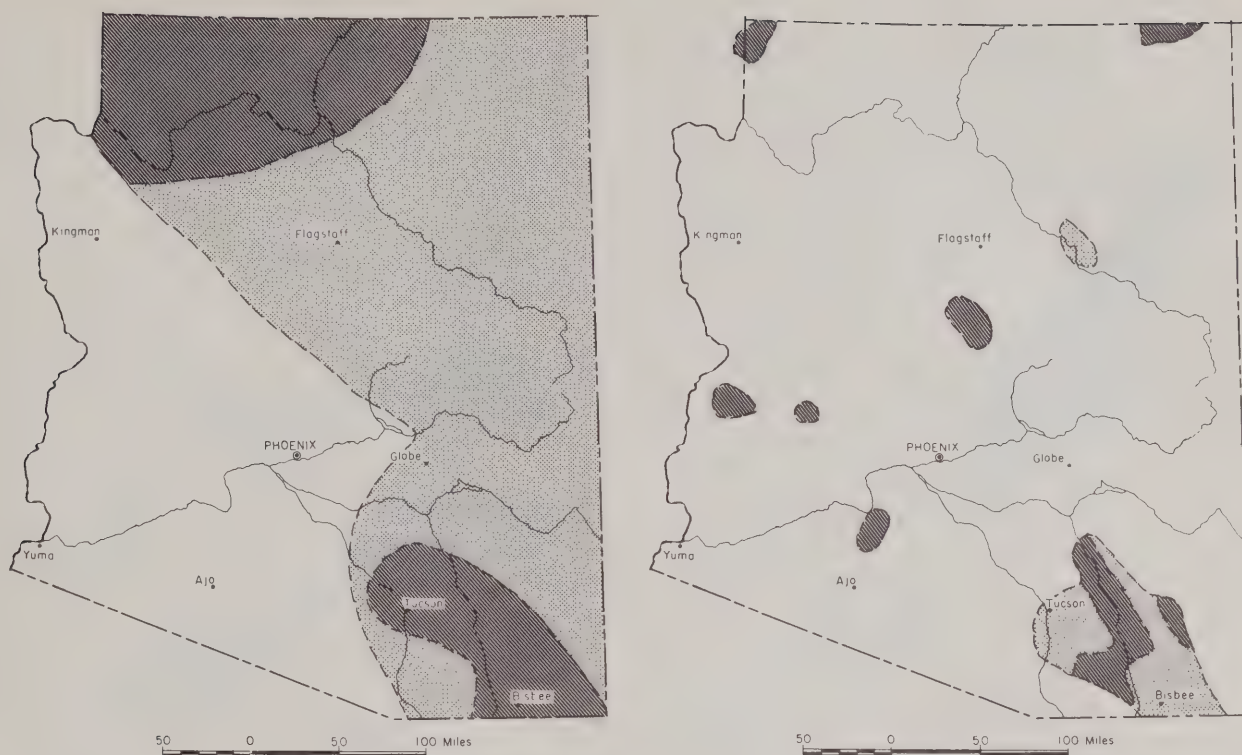
discoveries and developments — is immeasurable. It is sufficient to say that the leached-outcrop concepts rank high among the most important events in porphyry-copper history, and Arizona owes much to the men who developed them.

This is the porphyry-copper story. It is an Arizona story, a story of endowment, a story of men.

Industrial Rock and Mineral Resources

Industrial rock and mineral resources include those non-metallic minerals or mineral aggregates which are neither organic fuels nor sources of metals. Their development has lacked the glamour of the metallic deposits since these commodities are almost always low in unit value and generally consist of common rock materials — there for the taking. Their value generally is dependent upon development of local markets, so interest in these resources rises with population growth.

The rapid population increase in the Southwest with accompanying expansion of highway and building construction is stimulating interest in Ari-



Figs. 3-4. Paleozoic limestones (left) with potential as cement materials (stippled), and chemical lime (crosshatched). Basins of Tertiary age gypsum deposits (crosshatched) and of Permian and Triassic age (stippled)

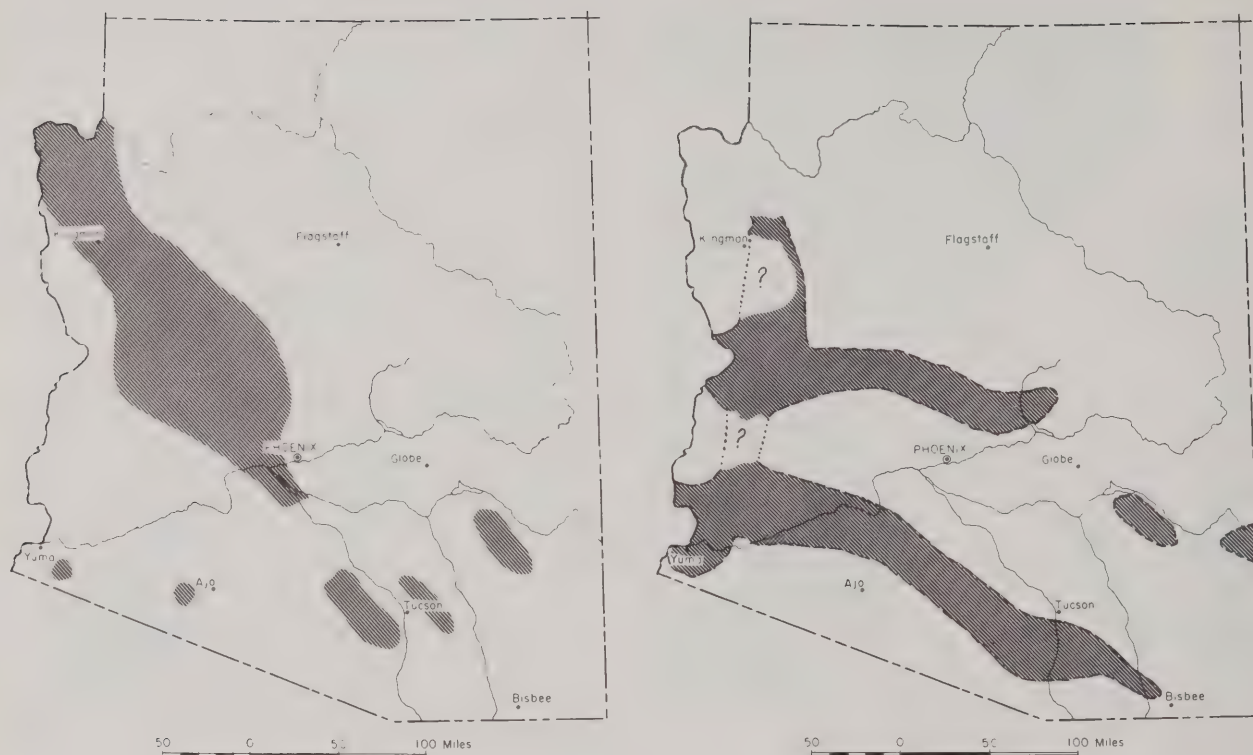
zona's industrial rocks and minerals. In 1958, these constituted 6.7 per cent of the total value of mineral production in the state, as compared to a 2.5 per cent average to date. Most of the products have been used locally, but a few of the products with higher unit value, such as asbestos, and beryl, columbite, and tantalite by-products are marketed outside of the state.

INDUSTRIAL ROCKS. The complex geological history in Arizona has resulted in a wide variety of industrial rocks. These include low-unit-value rock materials of sedimentary, igneous, and metamorphic origin which have widespread distribution, are mined and utilized in bulk, and require only simple processing, such as sand and gravel, building stone, volcanic cinders and pumice, perlite, clay, limestone, and gypsum deposits.

Relatively recent uplift of mountain ranges and their erosion in southwestern Arizona have produced vast resources of sand and gravel filling the broad intermontane valleys. These cover approximately one-half of the total land area in southern Arizona. Mountain streams emerging from the narrow can-

yons deposited their load of sediment as alluvial fans, and these were modified and reworked by the more leisurely flowing valley streams to produce imperfectly stratified sand and gravel with silty clay lenses. In northern Arizona the sand and gravel deposits are limited to narrow stream beds or to remnant terraces.

Explosive volcanic activity from Early Tertiary to Recent time has yielded a variety of industrial rock materials. Volcanic cinders (scoria), pumice and pumicite, and pozzolan materials occur in widely separated areas throughout the state (Fig. 2). Cinder cones of geologically recent volcanoes abound north and west of Flagstaff (Coconino County) and occur as isolated cones east of Douglas (Cochise County). Pumice is found west, east, and northeast of Flagstaff and east of Safford (Graham and Greenlee counties). Pumicite, volcanic ash or tuff, and pozzolan materials are widespread through the Tertiary and Quaternary volcanics that cap much of the state and are interbedded with the lake deposits. These beds are particularly well developed in the Tertiary Bidihochi formation near Chambers (Apache County). Perlite, a glassy siliceous rock which expands many times



Figs. 5-6. Pegmatite belt (left). Fluorite, barite, celestite, and beryl areas (right)

in volume when heated to the proper temperature, abounds in the area northwest, west, and southwest of Superior (Pinal County). Less extensive deposits of good quality occur south of Casa Grande (Pinal County) and west and northwest of Yucca (Mohave County).

Outpourings of volcanic flows and uplift of mountain ranges during Tertiary time dammed valleys and impounded lakes which received clastic sediments, and volcanic ash, and were fed by hot springs of volcanic origin. A wide variety of industrial rock materials resulted: structural, ceramic, and bloating clays, bentonite, bleaching clays, diatomite, pozzolan materials, chalk, gypsum, salt, sodium, sulphate, zeolites, and possibly boron salts. Extensive Tertiary lake deposits are found, or may be disclosed by further search, in the Salt River, San Simon, Sulphur Spring, San Pedro, and Santa Cruz valleys in southeastern Arizona and the Verde Valley in central Arizona (Fig. 2), and in the valley of Red Lake north of Kingman (Mojave County), and in the vicinity of Chambers (Apache County).

Mesozoic and early Tertiary rocks of Arizona consist of marine, near-shore, and continental depos-

its containing a variety of industrial rock materials. Cretaceous Mesaverde and Mancos formations and the Jurassic Morrison formation in north central Arizona contain illitic and kaolinitic clays suitable for structural, ceramic, and possible refractory products. High-swelling bentonite occurs in the Triassic Chinle formation, and restricted lenses of gypsum are found in the Triassic Moenkopi formation in Coconino County. Lime is produced from the Cretaceous Mural formation in the southeastern portion of the state.

Paleozoic rocks, consisting of limestone, shale, sandstone, quartzite, and gypsum are distributed through eastern and northern portions of Arizona and yield a wide variety of industrial rock products. Cement materials occur throughout the entire area (Fig. 3). High quality limestone is restricted to the Mississippian Escabrosa and Redwall formations in the northwest and southeast corners of the state, and gypsum to the Permian Andrada formation in the southeast portion of the state. (Fig. 4). Suitable ganister materials may be found in Cambrian and Permian quartzites.

Dimension stone is available in all parts of the



Fig. 7. Areas containing deposits of asbestos

state in rocks ranging from Precambrian gneiss and granite to Quaternary volcanics. Special quality dimension stone and flagstone is quarried from the Permian DeChelly, Coconino, and Triassic Moenkopi formations in north central Arizona.

INDUSTRIAL MINERALS. Igneous, hydrothermal, and metamorphic processes have resulted in the formation and concentration of various industrial minerals in pegmatites, veins, or metamorphic aureoles. Contrasted with the industrial rocks these deposits are more restricted in distribution, generally of small bulk, have a higher unit value, and generally entail more complex beneficiation processes. They include such minerals as asbestos, feldspar, mica, lithium minerals, beryl, fluorspar, and barite.

Deposits of pegmatite concentrations are known in many parts of Arizona; however, most of the largest and best known deposits lie within a belt some thirty to eighty miles wide and extending south-southeast from Lake Mead, across the state through parts of Mohave, Yavapai, Yuma, and Maricopa counties, and tailing out southeast of Phoenix (Fig. 5). These deposits have produced feldspar (perthite), ceramic grade quartz, scrap and sheet mica, lithium

minerals, beryl, tantalite, and columbite. The pegmatites occur typically as lenticular dikes, sills, pods, or irregular branching masses, often in groups or swarms. They average less than forty feet in width and 400 feet in length and generally show zonal structure with siliceous cores which commonly carry the unusual industrial minerals.

Veins of fluorite and barite are almost entirely restricted in their distribution to two belts trending west to west-northwest across the southern part of the state (Fig. 6). Both are common gangue minerals for lead veins and may either occur together or separately. There appears to be a close relationship of the distribution of beryl and celestite to these same distinct mineralized belts.

Arizona's chrysotile asbestos has been valued highly because of its low iron content and soft spinable fibers. The most important deposits are found in the late Precambrian rocks in central Gila County in the vicinity of Globe (Fig. 7). Some small deposits have been found in the Grand Canyon area (Coconino County). The asbestos occurs with serpentine in the Precambrian Mescal or Bass dolomite near the contacts of diabase dikes and sills.

OUTLOOK. The outlook for industrial rocks and minerals in Arizona is exceedingly bright. Population growth, with expansion of construction programs, and development of chemical and ceramic industries will utilize known deposits, develop new requirements and stimulate renewed search and discovery.

Mineral Fuels

The industrial development of any nation or state is to a large extent controlled by its sources of energy. The principal sources available to Arizona are water power, solar energy, radioactive minerals, and the mineral fuels. Mineral fuels in this section include coal, gas, and oil.

Water power, solar energy, and radioactive minerals are discussed elsewhere in this volume. Wood as a source of energy has only limited use because it neither furnishes the volume nor intensity of heat needed for industrial purposes.

The mineral fuels may be regarded as solar energy which was stored by plants or animals during past ages. This energy is released through the combustion of these residual, modified organic remains. **OIL AND GAS.** If oil or gas is to be discovered in commercial quantities, at least four fundamental requirements must be met. If any one of these factors

is missing, no commercial production can be expected. The first requirement is the presence of source beds from which oil and gas have been derived. These source beds generally are black, organic-rich shale or limestone rocks.

The second requirement is an adequate reservoir in which oil and gas that has been derived from the source beds can be stored. Reservoir beds may be any porous rock, but they generally are either sandstone or carbonate formations. In rare instances non-porous formations such as shales, volcanic, and crystalline rocks may be sufficiently fractured to serve as reservoirs.

The third requirement is a trap to catch migrating oil and gas and to allow them to concentrate in sufficient quantities to form a commercial accumulation. Broadly speaking, most traps are either (1) folded structures, such as anticlines, domes, terraces, or noses, (2) faulted or broken rock structures, or (3) stratigraphic traps. The latter are traps related to changes in porosity and permeability of the rocks and are caused by unconformities, intrusions, lithification, solution, cementation, recrystallization, wedgeouts, reefs and related organic growths, changing conditions of sedimentation, and other geologic factors.

Finally, the fourth requirement is adequate cover to prevent the oil and gas which may have accumulated in the trap from escaping. Such cover is generally of some impervious sedimentary rock such as shale.

The presence of all four of these requirements does not assure the discovery of oil or gas, since other factors influence the possibilities, but without these four requirements the chances of finding commercial accumulation are essentially nil.

Therefore, in evaluating the petroleum bearing potential of any given region, it is prudent to examine the stratigraphic section in detail in order to determine the presence of any source beds, reservoir beds, and traps.

Because of these fundamental requirements, it is obvious that sedimentary rocks are the usual habitat of oil and gas, and in particular, marine sediments are most favorable, although small amounts of oil and gas have been discovered in nonmarine rocks.

Furthermore, in general, the thicker the stratigraphic section the greater is its oil or gas potential. Conversely, if the section is thin or is largely composed of redbeds and nonmarine beds, the probabilities of finding oil or gas in it are poor.

In general, the most favorable areas for oil and gas accumulation are those that have had gentle structural deformation such as occur when rocks are folded into anticlines, domes, and noses. Where the beds have been much broken and fractured, oil or gas which might have accumulated in a reservoir may have escaped.

Although small igneous or volcanic intrusions may produce traps, a small intrusive implies additional igneous activity at depth. The heat accompanying extensive igneous activity probably will have destroyed any adjacent petroliferous possibilities, unless the intrusion occurred prior to the time of accumulation.

History of Exploration. According to Philip Johnson of the U.S. Geological Survey, the earliest known oil test well in Arizona was drilled during 1906, by A. C. Alexander in section 17,T.5S., R.24E., Graham County. It was abandoned as a dry hole at 1,400 feet. Between the years 1906 and 1948, about ninety additional oil test wells were drilled. Many of the data on these older wells are lacking, although in a few cases logs and other information have been secured. Most of these holes were shallow and were located without benefit of geology or geophysics, and had little relationship to fundamentals controlling the occurrence of petroleum. Some logs report "shows" of oil and/or gas, but quantitative data on these shows are lacking. Since 1949, about 150 additional wells have been drilled. For most of them some kind of record has been preserved. In many cases cuttings, cores or core chips, records of testing, and other pertinent data are on file.

Information on these wells has been assembled in the offices of the U. S. Geological Survey, Tucson, and in the Department of Geology and the Arizona Bureau of Mines of the University of Arizona, Tucson. Samples of Arizona well cuttings are available at the Arizona Bureau of Mines. Records and samples of wells drilled in the northern part of the state are on file at the Museum of Northern Arizona, Flagstaff. An addition set of cuttings is on file in the office of the Oil and Gas Commission, Phoenix.

As Figure 8 shows, the drilling in Arizona has been concentrated particularly in the northeastern and southeastern parts of the state.

The depth range of most wells has been only a few thousand feet, but a hole thirty miles south of San Simon in Cochise County reached a total depth of 7,579 feet, the deepest to date in Arizona.

Although shows of oil and gas have been recorded

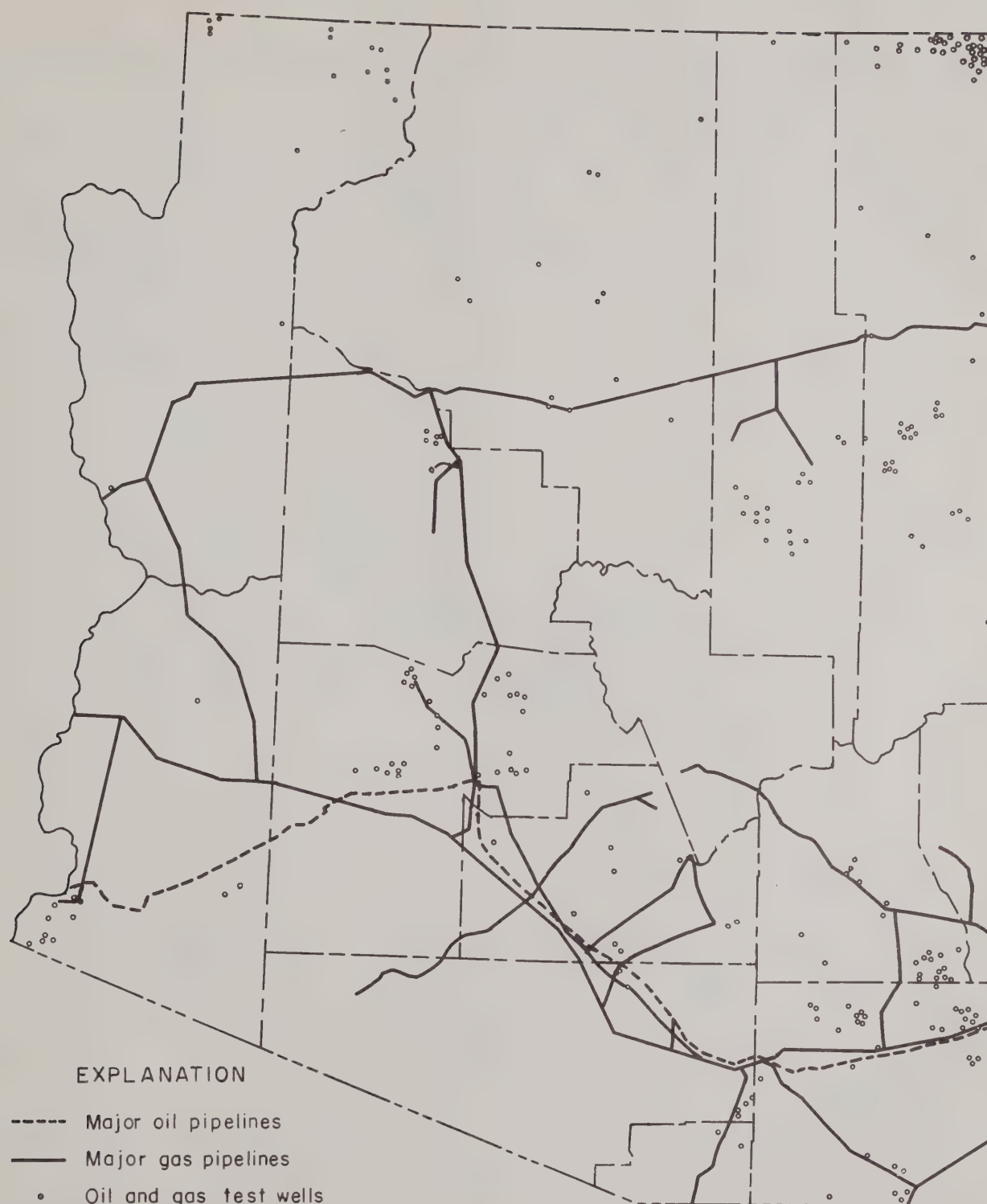


Fig. 8

for several wells, the only commercial production found has been in the Four Corners region. It was obtained first in 1954 when the Shell Oil Company

No. 2 Boundary Butte well in Sec. 3, T.41N., R.28E., was completed for an initial yield of 2,200,000 cubic feet of gas per day. This well is considered

the discovery well of the East Boundary Butte pool. In 1958, the Humble Oil Company, No. 1E Navajo, was drilled in the same pool, and came in as the first oil well of Arizona, with initial production of 562 barrels of oil per day from the Hermosa formation. Subsequent production showed increasing gas, and it is now considered a gas well.

In addition, in various parts of northeastern Arizona, certain wells in the Coconino formation were found to have gas containing as high as eight per cent of helium. The rest of the gas is mainly nitrogen. The helium content makes these wells important as a source of that gas.

Petroleum Possibilities of Arizona. Arizona may be divided into northwestern, northeastern, southeastern, and southwestern regions. The northwestern and northeastern regions comprise, in general, the Plateau portion of Arizona. The southeastern region includes that part of Arizona east of Tucson and south of the Plateau, and the southern and western parts of Arizona comprise that portion west of Tucson and south of the Plateau.

NORTHWESTERN ARIZONA. In northwestern Arizona a thick marine section is present which should be favorable for the occurrence of oil and gas. However, locally deep canyons have cut entirely through the section and the oil and gas may have escaped. Nevertheless, there are structures which may have served as traps for some local accumulation. Oil shows have been reported from a number of formations and some production has been secured in Utah.

Volcanic rocks between Flagstaff and Seligman cover much of the area, but presumably the underlying sedimentary rocks are similar to those exposed farther north, east, and west. The intrusives which fed the volcanoes in the area locally may have destroyed any oil present. Also the volcanic flows mask the structure.

NORTHEASTERN ARIZONA. In northeastern Arizona, Paleozoic rocks are overlain by Triassic and Jurassic nonmarine redbeds and sandstones. These in turn are overlain by Cretaceous marine beds. The Paleozoic section may be thin or almost absent, as on the Defiance Uplift. In other areas the section may be relatively thick. Rocks of Cretaceous age largely are limited to the Black Mesa Basin, and because of erosion, are relatively thin. Some of the extensive Cretaceous sandstones which produce in New Mexico are present in the Black Mesa Basin, but because of thin cover or exposure probably have lost any oil or gas they may have contained. Triassic

and Jurassic sandstones beds serve as reservoirs for natural gas which may carry small percentages of helium.

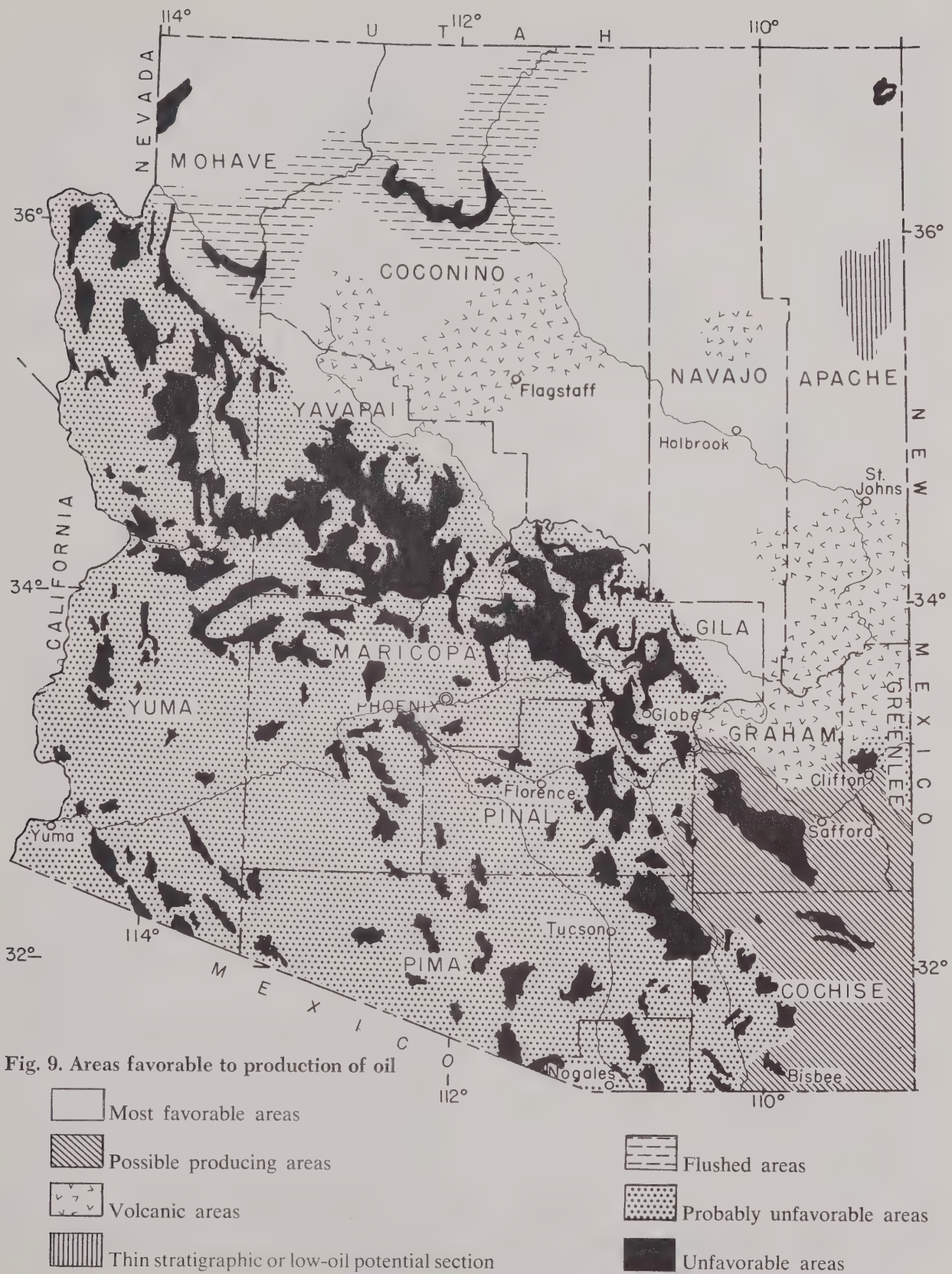
The Hermosa-Paradox formation complex occurs in the extreme northeastern corner of the state. These interfingering Permo-Pennsylvanian limestone, red-bed, evaporite, and shale facies have yielded oil and gas in the Four Corners. The oil and gas potential of the pre-Pennsylvanian beds is not known, although they are largely of marine origin. The recent discovery of oil, however, from the Mississippian section in the Texas Pacific Coal and Oil Company No. 1 Navajo-138 well is significant because of the widespread distribution of Mississippian rocks in the state.

The Hopi Buttes volcanic field and other volcanic intrusives present in northeastern Arizona may have done no vital damage to the oil potential, but subsurface volcanic alteration must be expected. Likewise, the extensive volcanic fields in the Greenlee and southern Apache County areas mask all of the subsurface and volcanic intrusions, and alterations have probably destroyed any oil and gas potential which might have been present.

SOUTHEASTERN ARIZONA. East of Tucson and south of the Plateau, a thick section of Paleozoic marine limestone, sandstone, and shale occurs. This rock section has all of the attributes necessary for an oil province. The rocks, however, show considerable faulting and locally are extensively intruded and mineralized. Mountain blocks are relatively narrow, and any oil that may have been present in these tilted blocks will have escaped. Within the basins the same Paleozoic section may be present; however, thick sections of sand, gravel, and clay mask the character of the older section and conceal its structure. The San Simon well penetrated more than 7000 feet of this alluvial fill without passing into the underlying bedrock. Also, since the basins are narrow, in most cases the area available for oil drainage into a pool is limited.

The post-Paleozoic rocks exposed are largely continental redbeds of Upper Cretaceous age. These are overlain by Tertiary rocks which in many places include extensive volcanics. In the extreme southeastern portion of the state, the Lower Cretaceous rocks become marine in character. Under proper conditions, these marine Cretaceous beds might carry oil.

The most likely rocks in which oil or gas may be found in southeastern Arizona are the Devonian,



Mississippian, Pennsylvanian, and Permian marine beds. The tongue of Ordovician limestone present in extreme eastern Arizona is also a potential oil horizon.

SOUTHWESTERN ARIZONA. Southwestern Arizona consists essentially of mountains of crystalline and volcanic rocks separated by basins which are covered with alluvium. There are a few local exposures of Paleozoic rocks in this area, and southward in Mexico a rather extensive Paleozoic section is present. In western Arizona, however, the mountain blocks in general appear to have essentially no potential oil section, and the basins are too deeply covered with alluvium to evaluate adequately their geology. In general it is believed, on the basis of water wells and other information, that in the basin areas marine sedimentary rocks are relatively thin or absent. Thus, in southern and southwestern Arizona the oil potentiality is slight.

POSSIBLE PETROLIFEROUS REGIONS IN ARIZONA. The petroleum potentiality of Arizona as controlled by stratigraphic relationships is summarized in Figure 9. The areas occupied by crystalline rocks have no potentiality and are indicated. Areas masked by volcanic rocks are also depicted. Southern and western Arizona as a whole are largely masked by Tertiary cover and difficult to assess. In general the western part is considered to have very limited possibilities, and the eastern part to have some possibilities of oil production. The area around the canyons may have lost their oil potentiality through drainage. This leaves a region in northeastern Arizona which probably is the most favorable in the state for the occurrence of oil and gas.

SOME OIL ECONOMICS. The future production and development of oil and gas in Arizona are closely tied to the problem of marketing them. Gas cannot be marketed without a pipe line. If no gas pipe line exists, the well must remain shut in, or if gas is produced in association with oil, it must be burned or pumped back into the ground. In the case of oil, production may be stored temporarily in tanks but then must be transported to market by pipe line, rail, or truck. Oil and gas pipe lines usually are not built until substantial oil and gas reserves have been developed.

No rail connections extend into the Four Corners area. Some highways and roads are present, but wide areas have none. Several transcontinental gas and oil pipe lines cross the region. Once sufficient reserves are proved, pipe lines may be built to con-

nect the fields with these major pipe lines. At the present time plans for constructing certain gas and oil pipe lines are under consideration.

The nearest refineries for Arizona crude are in northwestern New Mexico and until pipe lines are established, crude will be transported by truck to them or to a rail or pipe line head. The ultimate market for gas will be Arizona and the Pacific Coast states.

The oil and gas pipe lines presently existing throughout the state are for transcontinental transportation and for distribution within the state of natural gas and refined oil products. Figure 8 indicates the position of the major trunk lines.

COAL. Coal is derived from vegetable material. In the coalification process, the woody material of plants passes successively into peat, lignite, bituminous coal, and anthracite. In rare instances where hot liquid intrusive rocks have come close to a coal seam, the coal may be baked and changed into a natural coke.

The change from wood to peat occurs early in the process and is essentially a decaying and hydration step. Withdrawal of swamp water and gradual burial and compaction due to weight of overlying sediments change peat to a lignite which commonly carries up to about 30 percent water. Lignite has a relatively low heating value, in the range of 8,000 B.T.U. (A British Thermal Unit is the amount of heat necessary to raise 1 cubic foot of water 1° Fahrenheit.)

The change from lignite through sub-bituminous and into bituminous coal also is primarily dehydration, together with some loss of volatile materials. Bituminous coal normally has only about 5 percent moisture. Heating value may increase to over 15,000 B.T.U. This change to bituminous coal is primarily the result of compaction due to overburden and to other stresses in the earth. Length of burial of the coal does not seem to be very significant, although in general the older the coal the higher the rank. Rank designates the quality of coal and is indicated by the terms lignite, bituminous, or anthracite.

The change from bituminous through super-bituminous, sub-anthracite, and anthracite is primarily a loss of volatile materials such as hydrogen compounds. Moisture content on an ash-free basis has dropped to about 3 percent, volatile material to about 5 percent, and there has been a corresponding increase to about 92 percent fixed carbon. The heating value, because of the loss of volatile material,

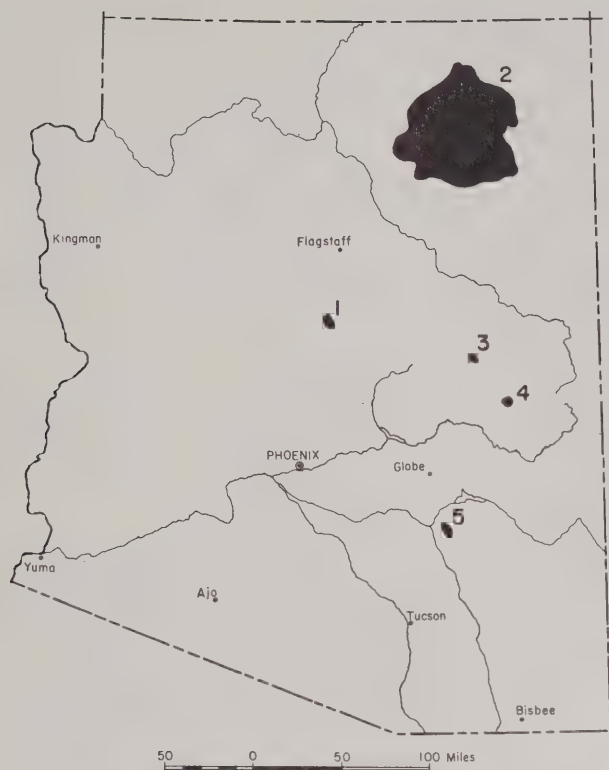


Fig. 10. Known coal areas in Arizona

has dropped somewhat but still is in the vicinity of 14,000 B.T.U.

Most of the coals of Arizona fall in the sub-bituminous to bituminous range. The age of the Arizona coals are Pennsylvanian and Cretaceous.

Pennsylvanian Coals. Coal occurs in Supai red-beds in the vicinity of Fossil Creek, southeast of Clarkdale, Arizona (Fig. 10). Details of the geology have not been determined, but apparently there are several seams which thicken back from the outcrop. The extent of the field and volume of coal are unknown.

A proximate analysis determines the percentage of moisture, volatile matter, fixed carbon, and ash present in coal. It reveals important characteristics of coal and permits its classification as to rank and use. A proximate analysis of this Supai coal shows its contents to be 5 percent moisture, 35 percent volatile matter, 44.4 percent fixed carbon, and 15.6 percent ash. The samples used for this analysis were taken from the outcrop and, therefore, tend to show higher ash, higher water, and lower volatile content than may be true for more deeply buried coal.

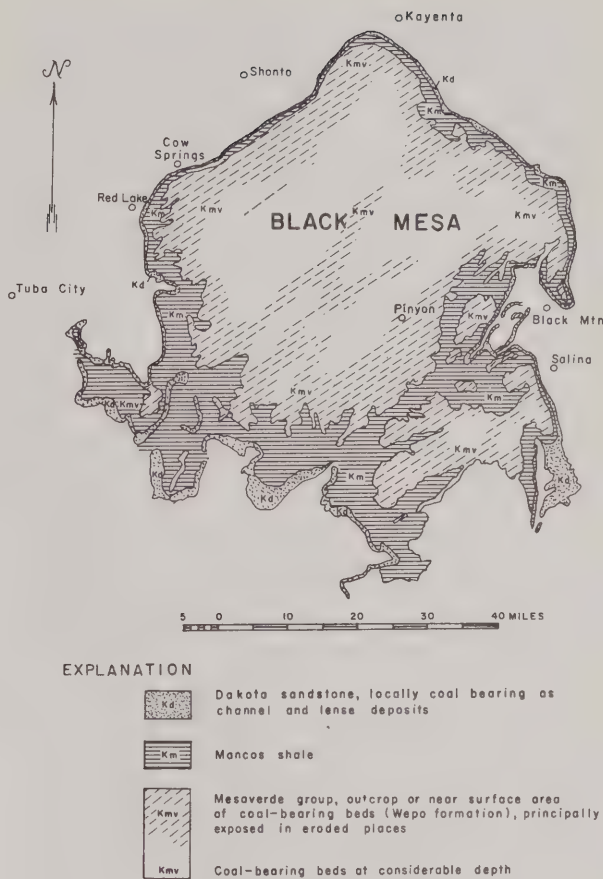


Fig. 11. Distribution of Dakota and Mesaverde coal beds in Arizona's Black Basin area

The samples indicate poor coking properties; however, the quality may improve in fresh samples. No sulphur determination was made, but the outcrop samples did not appear to contain much pyrite or marcasite. The ash is reported to contain a high percentage of copper.

Cretaceous Coals. The largest coal field in Arizona is in the Black Mesa Basin (Fig. 11). This field is adjacent to and closely related to the Gallup coal field in northwestern New Mexico. The coal seams are of Cretaceous age and are confined to the Dakota formation and Mesa Verde group of beds.

The Dakota coal occurs above the massive sandstone of the Dakota formation and consists of two-to-four foot beds although some lenses up to nine feet thick are present. The beds are highly lenticular. The coal is of low bituminous rank and contains substantial ash. The coal can be utilized locally but probably is unsuitable for large scale developments.

The Mesaverde coal is confined to the Wepo formation which occurs in the middle of the Mesaverde group. The coal beds are usually over four feet thick and may reach thicknesses in excess of ten feet. They are lenticular, although the coal-bearing portion of the section is fairly continuous. The coal ranges from high grade lignite to medium grade bituminous. It contains a moderate amount of ash and in places substantial sulphur in the form of pyrite and marcasite. Coking properties are poor. Its main use probably will be in steam plants and other power generation installations.

Most of the Black Mesa coal is produced by underground mining. At present a number of mines are operating, furnishing coal for local use. In a number of areas overburden is not excessive and strip mining methods can be utilized. The dip of the coal is gentle. Campbell and Gregory estimated 8 billion tons of mineable coal in the Black Mesa Basin; Kiersch estimates about 2 billion tons.

The Upper Cretaceous coal outcrop in the Pinedale-Showlow area is limited in extent. It is an erosional remnant of the more extensive Mesaverde coal area to the north and east. The character of the coal is similar. Two coal seams are present about fifteen feet apart. The upper one is about ten feet thick and is very dirty; the lower one is about three feet thick and is good sub-bituminous rank. Because of its distribution it will be limited to local use.

The coal in T7N, R23E, west of Whiteriver, is a low grade, thin-bedded coal in shale, and is probably a continuation of the Pinedale-Showlow field. Its age is Upper Cretaceous. It was mined until about 1930.

The Deer and Ash Creek basins near Hayden contain coal of Upper Cretaceous age. Surface

exposures indicate several thin seams, none over three feet thick. The coal is dirty and frequently has shale and sand partings; sulphur and ash content are high. The coal may be badly crushed although in places it is hard. The area is limited and there are structural complexities. Dips of the coal in places are steep and topography is rugged. The coal is of such poor quality that to date little work has been done on its distribution and economics. It will be suitable for local use only. An estimate of 30,000,000 tons has been given for the area but this is probably high.

The areas discussed above contain the only large-scale coal deposits known in Arizona. Detailed work may locate other occurrences of coal in the state, but probably no extensive high grade coal deposits remain undiscovered.

SUMMARY. Northeastern Arizona is most plentifully supplied with energy available from coal, oil, and gas deposits and transcontinental railroads and pipe lines connect northern Arizona with major out-of-state producing areas.

Southern Arizona does not possess extensive coal deposits and any oil and gas fields which may be discovered will be limited in extent. The area is not easily connected directly by railroad with major coal deposits, and distances to them, for economic reasons, at present, preclude extensive industrial utilization of coal as a source of energy. Natural gas and oil pipe lines connect southern Arizona with out-of-state sources and these mineral fuels can economically be imported to supply necessary industrial energy. Direct connection with northeastern Arizona and Four Corners oil and gas fields may develop as demand for the products increases and as known oil and gas reserves increase.

..... *plants*

MUCH IS HEARD OF "THE GOOD OLD DAYS," "GRASS as high as a man," "miles and miles of good grazing for animals," etc. It is always man who is responsible for the change for the worse — whether through overgrazing by livestock, carelessness with fire, or over-cultivation. Occasionally one hears that Arizona is drying up, and rainfall is not "what it used to be."

That there have been dry spells and wet spells is well-known, but as for a drastic change one way or another, we are still speculating. James R. Hastings of the University of Arizona has recently written a paper comparing various early accounts of the Southwestern vegetation and showing how even the same area was not consistently described. Comparative pictures have been published illustrating the same conclusion.

There have been such recent changes as the spread of mesquite in southern Arizona and the spread of piñon and juniper in the north, but these are part of local cycles. On the whole, Arizona's present vegetation is much the same as when the White man first arrived, and it promises to be better in the future with new concepts of management.

Vegetation is a product of the environment in which it grows. With extremely diverse topography and soils, the conditions encountered throughout Arizona make varying habitats available to plants representing north, east, south, and west.

Ecological Setting

Arizona divides roughly but nicely into the northern half, on the Colorado Plateau, and the southern half with its basin and range topography.

The separation between these two diverse areas is the escarpment that creates the Mogollon Rim, a well-defined landmark along the northern boundary of the Tonto Basin north of Payson. The northern plateau area slopes gently downward to the north and is dissected by the Colorado River and the Little Colorado, as well as by many smaller streams. Characteristic of the area are the flat-top mesas. This plateau is penetrated in places by volcanic activities that result in features like the famous San Francisco Peaks at Flagstaff, or the extensive, less well-defined lava flows in the White Mountains of Apache County. The southern half of the state contains the Basin and Range area and is in general lower in altitude, consisting of numerous mountain ranges separated by alluvial valleys.

At Yuma in the southwest corner of Arizona, where the Colorado River leaves the state, the elevation is about 100 feet above sea level, while only slightly over 250 miles northeast, the lofty San Francisco Peaks rise to an elevation of over 12,600 feet. The ecologist recognizes a rule-of-thumb, which states that every 1000 feet in rise in altitude is the equivalent of about 300 miles distance north. Thus, while Yuma and the San Francisco Peaks are only some 200 miles apart geographically, they are some 3,600 miles apart ecologically. Yuma basks in a sub-tropical climate, while at the other extreme, on top of the San Francisco Peaks, a climate exists similar to that of the northern realms of Canada and Alaska.

Altitude is not the only variable to be considered. The distribution of plant life is dependent on a number of variable environmental factors, all interacting, which *in toto* establish the type of vegetation en-

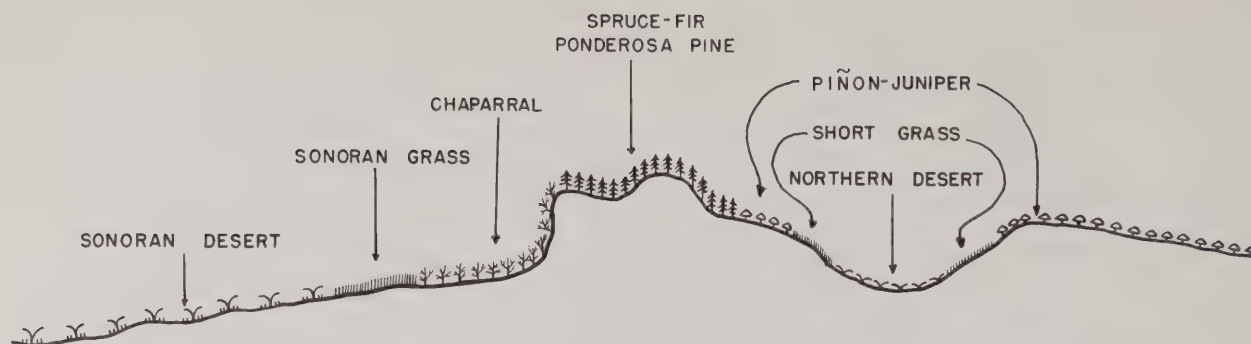


Figure 1 — Typical profile of Arizona from north to south showing relationships of various vegetation units. Below is a summary of principal vegetation types in Arizona (adapted from Little, 1950).

<i>Name of Vegetation type</i>	<i>Characteristic plants</i>	<i>Elevation (feet)</i>	<i>Rainfall (inches)</i>	<i>Percentages of Total Vegetation</i>	<i>Location in Arizona</i>
Alpine tundra (Arctic-Alpine Life Zone).	Mountain avens, alpine sedges, and grasses.	11,500–13,306	30–35	...	Above timber line on summit of San Francisco Mountain.
Forests					
Spruce-fir forest (sub-alpine forest, Hudsonian and Canadian Life Zones).	Engelmann spruce, alpine fir, corkbark fir.	8,500–12,000	30–35	1	High elevations, White Mountains, San Francisco Peaks, and Kaibab.
Douglas-fir forest (montane forest, Canadian Life Zone).	Douglas fir, white fir, quaking aspens, limber pine.	8,000–9,500	25–30	2	High mountains in eastern and northern parts.
Ponderosa pine forest (Transition Life Zone).	Ponderosa pine, Arizona pine.	5,500–8,500	19–25	6	Mountains and plateaus in northeastern half.
Piñon-juniper woodland (Upper Sonoran Life Zone).	Piñon pines and various junipers.	4,500–7,500	12–20	17	Plateaus and mountains in northern half.
Chaparral-Oak woodland (Upper Sonoran Life Zone).	Shrub live oak, manzanitas, sumacs, cliff-rose, ceanothuses.	4,000–6,000	13–25	8	Mountains in central part.
Grasslands					
Short grass (plains grassland, Upper Sonoran Life Zone).	Blue grama, hairy grama, galleta, buffalograss.	4,500–6,500	9–20	15	Plains and plateaus in northern part.
Desert grass (semidesert grassland, lower Sonoran Life Zone).	Black grama, tobosa, dropseeds.	3,000–5,000	9–18	10	Plains in southeastern part.
Deserts					
Sagebrush (northern desert, Upper Sonoran Life Zone).	Big sagebrush, black brush.	2,500–6,000	7–17	6	Lower portions of northern area. Little Colorado River drainage.
Desert (semidesert shrub, Lower Sonoran Life Zone).	Creosote bush, mesquite, tarbush, acacias, palo-verdes, bur sages, cacti, saltbush.	100–4,500	3–15	35	Southwestern half of the state and bottom of Grand Canyon.

countered. Temperature, rainfall, slope, soil—man himself—all contribute to the vast complex of interacting factors. Some of the factors encountered in the Southwest tend to the extremes. Often it is these maximums and minimums that are decisive in determining the type of vegetation found in a given area.

In general, forests occur where the soil is moist throughout the year and especially during the growing season. Where an extreme dry period occurs during the year, or where the soil does not remain moist because of low rainfall, grasslands are found. Deserts, regions of sparse vegetation, are found in areas of warm temperatures with low rainfall that seldom moistens the soil to a depth of more than a few inches.

Deserts are regarded by the layman as areas of no vegetation. If such were the case, deserts would be rare, because even under the most extreme climatic conditions, some plant life can exist. Areas of shifting sand dunes, the popular conception of a desert, are deserts of extreme barrenness because of the shifting sands rather than because of lack of moisture. The so-called desert areas of the Southwest and of Arizona are better thought of as semi-deserts or semiarid areas. The growth of vegetation on the desert areas of Arizona is sparse when compared to the growth in eastern areas of the United States, but the Arizona deserts are rarely devoid of all vegetation.

Forests, grasslands, and deserts exist then, mainly because of variations in rainfall and temperature. In order to understand the plant cover found in Arizona, one has to become familiar with the rainfall patterns and the temperature variations; these are closely allied to the general topography and the larger climatic patterns. Western Arizona gets its moisture from winter storms and summer thunderstorms in about equal proportions. On the eastern side of the state the rainfall comes mostly from summer thunderstorms. Winter rains are less important in shaping the vegetation pattern. The physiographic features that so strikingly shape the rainfall patterns, and the temperature variations as a result of elevation and slopes are discussed in another section of this book and should be consulted in connection with the vegetational patterns.

In order to understand the plan of vegetation within Arizona, one should first inquire into the vegetation pattern of larger surrounding areas. Elements of Arizona's vegetation come from all points of the compass. Regions to the north contribute two



— Tad Nichols

Aspen — north in Arizona's high altitudes

main vegetational types, the coniferous forests and the cold desert. From the circumpolar belt of coniferous forests Arizona has coniferous elements. Going south, conifers are found higher and higher on the plateaus and mountains. This forest region culminates, in Arizona, along the high rim of the escarpment forming the southern limit of the Colorado Plateau. Here, stretching from the New Mexico boundary to the vicinity of Williams, is a great belt of coniferous forest. Smaller areas are found on the higher regions north and south of the Mogollon Rim country, and it is often these isolated forested regions that claim the careful attention of the plant geographer. In addition to the southern extensions of the northern coniferous forest on this plateau, there is also an extension of the Great Basin desert about Great Salt Lake. This cold winter desert follows the low-lying land of the eroded river valleys in northern Arizona and is very striking along the northern portion of the Colorado River and its main tributary in the state of Arizona, the Little Colorado River.

A large area of grassland in northern Arizona is closely related to the Great Plains. This vegetation is usually thought of as a western extension of the short grass plains, lying just east of the Rocky Mountains.

The region south of Arizona contributes another grassland as well as desert species. In southeastern Arizona, there is an extension of the Sonoran grassland. The desert of the southwestern part of Arizona represents a continuation of the desert of Sonora. Along the Colorado River in western Arizona are regions representing extensions of the southern California deserts. Also related to the vegetation of California is chaparral, a curious mixture of grasses and low shrubs, that forms margins along the southern desert and the Sonoran grassland.

Depending on the authority consulted, Arizona's vegetation is divided into from three to twelve different types. These extremely diverse vegetation units make Arizona's plant life among the most varied in the Union. For the purpose of this study, Arizona's vegetation can be divided into four main divisions: Alpine, Forest, Grassland, and Desert, and certain subdivisions can be recognized.

ALPINE. Typical alpine vegetation is very limited in Arizona and occurs only on the San Francisco Peaks, which go above tree line to 12,655 feet. The vegetation at the summit of Baldy Peak (11,500 feet) in the White Mountains comes very close to being alpine in character. Such areas are interesting to the botanist because of the alpine plants, that often represent the southernmost limit of some plants very common further north. These outlying stations of alpine species connect this type of vegetation with the alpine and arctic flora of the circumpolar regions. The following figures show the clear relationship of this vegetation with the north:

	Number of Species	Percentages
Arctic — alpine		
circumpolar species	15	30.6
North American arctic		
alpine species	5	10.2
Rocky Mountain		
alpine species	24	49.0
Southwestern species	3	6.1
Endemic Species	2	4.1

FOREST. The sub-alpine, spruce-fir forest in Arizona occurs at elevations just below the tree line. The San Francisco Peaks, the White Mountains, the highest parts of the Mogollon Rim, and the Kaibab Plateau support stands of this forest type. Probably



— Esther Henderson

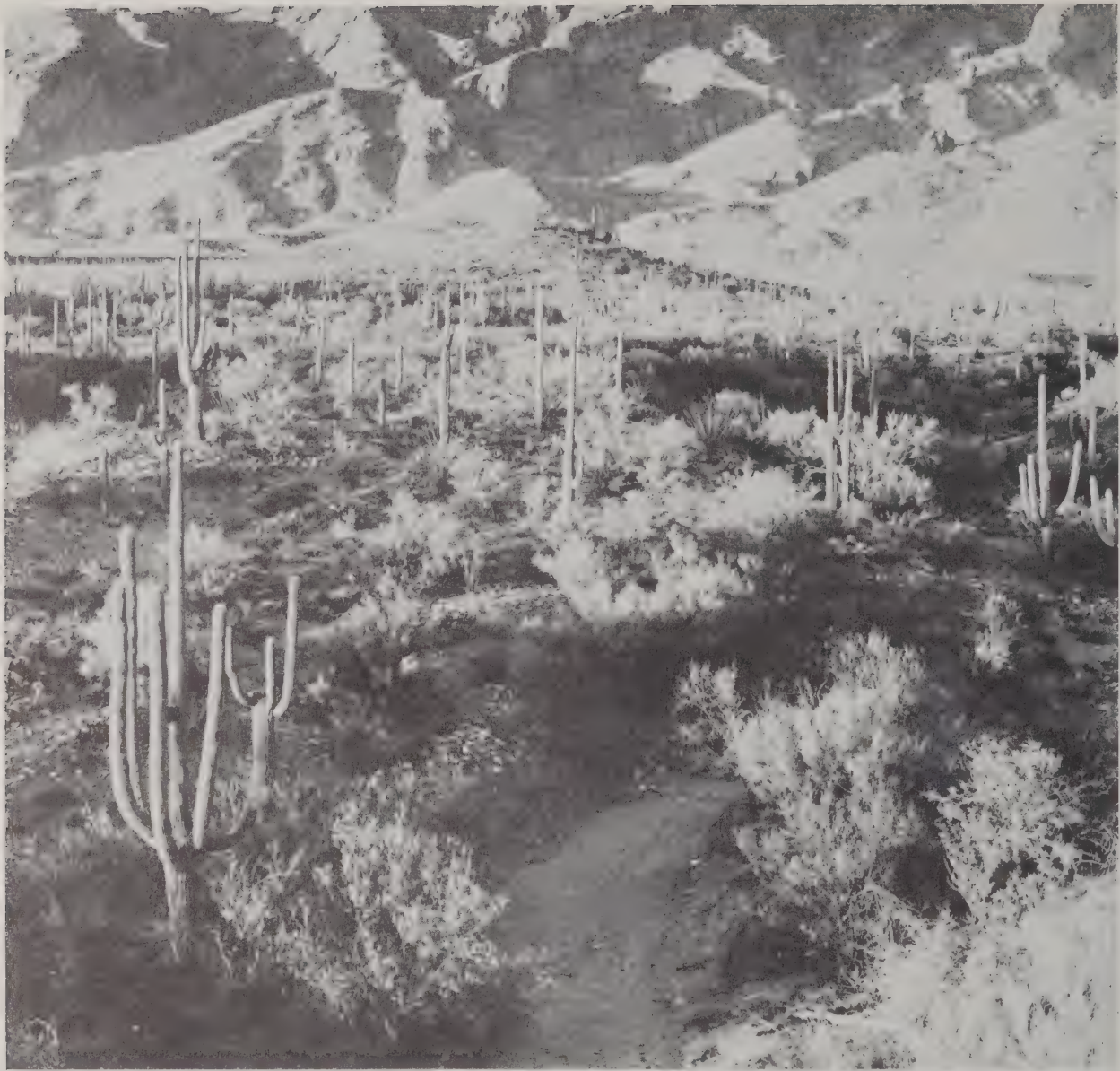
Night-blooming cereus — a desert plant

the best developed stands are those of the White Mountains. Open meadows of grass which are used extensively for summer grazing are interspersed in these forests along the streams. Engelmann's spruce and the two closely related firs, corkbark, and alpine, are the dominant trees, with scattered broad-leaved trees, mainly aspen. The Phelps Botanical Area on the east fork of the Little Colorado at the base of Baldy Peak has been set aside in the Apache National Forest as a study area for the spruce-fir forest. The flora is rich in sub-alpine species, both of animal and plants. A disjunct area of this forest is found on the top of the Pinaleño Mountains of Graham County. Some of Arizona's most delightful camping areas are found in forests of this type.

Ponderosa Pine. The most extensive forest type in Arizona, and also the most valuable economically, is the ponderosa pine. Only about 6 percent of Arizona is occupied by trees of sawtimber quality, and this forest type contributes almost all of it.



Conifer and aspen forest on the slopes of the San Francisco Mountains near Flagstaff



— Chuck Abbott

Saguaro — the state flower, native, unique, and abundant in Arizona's outwash plains

Pure stands of ponderosa pine occur on areas below the spruce-fir forests and merge on the north with piñon-juniper forest and on the south with the chaparral at lower elevations. The largest area of this forest occurs along the Colorado Plateau north of the Mogollon Rim from New Mexico to Williams, Arizona. Other stands are found on the Kaibab Plateau of the North Rim of the Grand Canyon and in the high mountains of northeastern Arizona. There are many isolated patches at high elevations in other locations such as in the vicinity of Prescott,

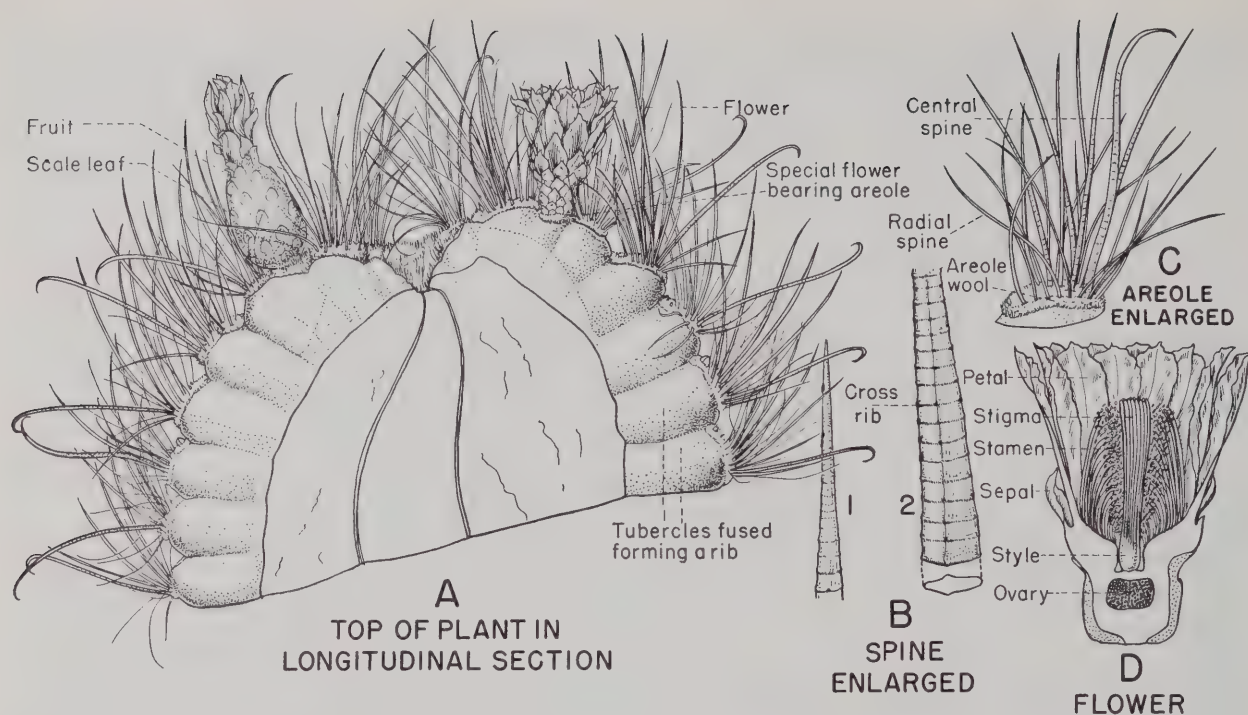
Jerome, and on isolated peaks in southern Arizona.

These forests of ponderosa pine are often quite open, and the discontinuous canopy provides openings where grasses form excellent grazing areas. In some of the finer stands of ponderosa pine, the grasses of the forest floor, along with the pines, make up the entire vegetation. In some areas there is developed an understory of broad-leaved shrubby species. The place of these shrubby species in the ecology of the ponderosa pine forests has been debated for a number of years. The definitive reason



— Chuck Abbott

Along southern Arizona's streambeds, the pale green cottonwood announces spring



Barrel cactus — longitudinal section of plant common in southern Arizona

for this shrubby growth has not been found, and work is still needed to solve this problem.

Not well-developed in Arizona but often recognized is the Douglas fir forest type which is found at the upper limits of the ponderosa pine forest and merges with the spruce-fir forest of the higher altitudes.

Piñon-Juniper. As one goes to lower elevations from the high country of the ponderosa pine, trees become smaller and spaced more widely, with the ponderosa pine eventually giving way to smaller and more shrubby types of conifers — the piñon pines and the junipers. This phenomenon of the replacement of ponderosa pine by the piñon pines and junipers is well shown on the road north from Flagstaff to Cameron (U. S. 89). As one descends into the Little Colorado Basin, the rainfall drops off from twenty inches per year at Flagstaff to only six inches per year at Cameron at the Little Colorado crossing, and the large ponderosa pines of the Flagstaff area become small and more widely spaced. Eventually the ponderosa pine is replaced by the piñons and junipers, which in turn are replaced by grasses in a gradual transition that is complete at Cameron where the northern desert takes over.

The piñon-juniper is a very distinctive type and

covers large areas in the northern half of the state at elevations between 4,500 and 7,500 feet. When the trees of this forest are not too close together, a good grass covering is found interspersed. This forest is a transition type between the forests and the grasslands and forms a variable boundary between these two vegetation types.

Chaparral-Oak Woodland. South of the ponderosa pine country of the Mogollon Rim, one encounters the same dwarfing of the trees that occurs to the north. However, the trees and shrubs that take over where rainfall becomes more sparse are not the piñons and junipers but various broad-leaved sclerophyllous shrubs. This type of vegetation called chaparral is as characteristic of the lower country south of the Rim as the piñon-juniper is of the lower country north of the Rim. However, the limits of the chaparral are not as sharp or as easily defined. The vegetation consists of shrubby oaks, sumacs, manzanitas, cliff rose, ceonothus, algerita, and buck-thorns, which at the lower altitudes to the south gradually are replaced by typical desert species of southwestern Arizona. Further to the southeast in the state at altitudes of 4–5,000 feet, the chaparral takes on the aspects of an oak woodland. This extension of the chaparral results in larger species of oaks



Blue grama — high elevation forage grass



Tobosa — low-to-medium altitude forage

and gives the grassland an appearance of an open park, again a transitional vegetation between forest and grasslands.

GRASSLAND.

Northern Grassland. Continuing to lower altitudes and lower annual rainfall, the trees get smaller and more scattered until finally only grass remains. These areas in northern Arizona below the piñon-juniper country and merging with it constitute one of the important grasslands areas in Arizona. Generally conceded to be a western extension of the Great Plains of the Central United States, they are continuous with the Great Plains through the low passes of the mountains of New Mexico. In addition to the grasses there are shrubs (winter fat and chamiso) in this type that yield excellent browse and in places

the grassland form stands almost pure.

Sonoran Grasslands. In the southeastern part of Arizona, the chaparral is replaced at the lower elevations by a grassland which represents an extension of the Sonoran Highlands grass type found in Mexico. Included in this area are isolated mountain ranges which are covered with the chaparral type vegetation. A few of the ranges are high enough to intercept rains that will support ponderosa pine forests, which are curious combinations of plants from the more northern coniferous forests and plants from the Sonoran Highlands to the south. Because of the milder winters, this grassland provides one of the best grazing areas in Arizona. It is where this grassland fringes the southern desert areas that mesquite has developed into a problem plant for ranchers.



— Forrest Shreve

Mesquite — bottomland tree that has spread to adjacent grassland areas of Arizona

DESERT.

Northern Desert. Along the Little Colorado River basin at the lower levels in northern Arizona, there is a desert type of vegetation which is a southern extension of the Great Basin Desert of the intermontane area in Utah. Small xerophytic shrubs characterize this desert and include the salt bushes, mormon tea, blackbush, and shadscale. The big sagebrush occupies some of the higher parts of this desert and is very prominent in the Strip Country of northwestern Arizona.

Sonoran Desert. Over a third of Arizona is covered by the desert vegetation for which Arizona is famed in word and picture. This is the land of the stately saguaro and other cacti, as well as of many plants with small, hard leaves. This has been called the microphyllous desert (referring to the small leaves), the succulent desert (referring to the water-storing habits of some of its plants), but is probably best known as the Sonoran Desert. It is mainly a northward extension of the desert of Sonora, Mexico.

This region is characterized by the typical basin

and range country. These desert mountain ranges of 3–4,000 feet altitude are separated by the broad alluvial filled valleys. The vegetation of the region is very closely related to the topography. The rough, eroding slopes of these many ranges are covered with palo verde, bur sage, cholla, prickly pear, yuccas, and agaves. Below the steep slopes are the outwash plains, here called bajadas. Here the most spectacular displays of cacti are found, including the saguaro.

As the bajadas level out to the alluvial plains, creosote bush makes its appearance. In the southwestern desert area, there are thousands of square miles covered with this well-known plant. In areas where drainage is not efficient, salt accumulations in the soil give rise to the playa vegetation, and the salt bushes with their high tolerance for salt take over. The stream beds, which in this area are dry much of the year, are lined with thickets of large trees and shrubs including the mesquite, catclaw, wolf berry, desert willow, and now the introduced tamarisk. The range of diurnal temperatures is great. The daytime



— Esther Henderson

Blue palo verde — the state tree, blooming a brilliant yellow early in Arizona spring

temperatures in the summer are high, and nights, especially in the winter, are cool but frosts are minimal. The rainfall is low and spotty. Torrential thunderstorms are the rule in the summers, and flash floods are common.

The vegetation of the region between Congress Junction and Kingman, and westward in the valley of the Colorado River and its tributaries north of Parker Dam is an extension of the Mohave Desert of California. One of the outstanding plants is the Joshua tree.

The region along the Colorado River south of Parker Dam is sometimes called the Colorado Desert. This desert type of vegetation is centered in the Salton Sea basin of California. The area in general is relatively frost-free and provides a habitat for some of our most frost-sensitive plants, such as the ironwood and smoke tree. It is also the best citrus-growing area of the state.

A General View

THE ABUNDANCE. In Kearney and Peebles'

Arizona Flora are listed 3,370 species of plants known from Arizona. These 3,370 species are in 907 genera and 132 families. This very rich flora is equalled by very few other regions of the United States. The composites, the grasses, and the legumes constitute the three largest families. Texas is the only state in this country with more than the 363 grass species recorded for Arizona. The cactus family, especially well-represented in Arizona, has seventy-one species native to the state. Arizona is also rich in members of the fern family and fern allies, nearly 100 species being known in the state.

The Value. The vegetation of Arizona is as varied as its topography; therefore, to place a monetary value on the plant life of a state used by nearly one and one-half million residents and hundreds of thousands of tourists is an impossible task. Some people are involved in businesses which utilize the vegetation through a removal of plants and plant parts, as lumbermen and cattlemen; many utilize the vegetation, knowingly or unknowingly, through its value in protecting watersheds; many are directly or in-

directly interested in the vegetation for its aesthetic value.

Usually one does not think of a desert state like Arizona having a lumbering industry. The ponderosa pine forests of the higher elevations have supplied raw material for lumbermills around which cities like Flagstaff and McNary have developed. It is estimated that Arizona has about 16 billion board feet of timber. This amount represents only a small portion of the annual demand in the United States, but by careful harvesting similar to that practiced on the Apache Indian Reservation, Arizona's lumbering industry will be on a sustaining basis.

One of the prime users of Arizona's vegetation is the cattle industry. Although the principal areas for cattle raising are centered in the northern and southern grasslands, cattle may be grazed on any vegetation type. The desert areas with their sparse grasses and predominant shrubs furnish browse and in a wet year good forage; however, these areas are easily over-grazed, and the carrying capacity of the vegetation varies with the rainfall.

Arizona's forests likewise supply grazing areas with a grass cover determined by the spacing of the trees. The grasses are likely to be sparse in the denser shade, but the open meadows scattered in the forested areas supply abundant grasses during the summer growing season. The grasslands also can and have been overgrazed, but careful management of this valuable vegetation will make possible the continuation of cattle-raising as one of Arizona's most important industries.

To evaluate in monetary terms the vegetation on Arizona's watershed is difficult, if not impossible. Water being one of life's necessities and one of Arizona's critical natural resources, the tendency is to do anything and everything possible to make more water available.

Water is needed by plants, as it is by most living things. This water is taken in by the roots, transported through the plant and part is utilized in various processes; however, much of the water taken in by the plants is returned to the atmosphere by the evaporation process termed transpiration. It is the transpired water which causes the difficulty with the water-users because man anticipates this as water he could use to irrigate his crops or support more people in his cities. Various proposals have been made to save this water for man's use, from the most drastic idea of denuding the mountain slopes to the suggestion of selective thinning. The first



— Chuck Abbott

Agave — also called mescal and maguey

proposal met with storms of protest from many directions.

The plants on a watershed have a great value for which the water they use is but a small price to pay. Their roots hold the soil and prevent erosion which would fill the reservoirs with silt; at the same time the roots keep the soil loose and porous so the water can soak into the ground to be released slowly and thereby prevent flash floods. Plants also shade the ground and prevent the loss of much water through evaporation of snow and water. Trees on the high-mountain watersheds slow the melting of snow packs, thereby extending the water supply over a longer period of the year to provide perpetual streams and reduce the risk of floods. Finally, the intangible aesthetic value of plants on a watershed and the value of the vegetation to the sportsman as a protection for game should be considered.

A consideration of the value of vegetation to the sportsmen should not be limited to that of the water-

shed, because game of one form or another is adapted to each type of plant association: deer and elk to the chaparral and mountain forests; quail to the grasslands, doves to desert river bottoms. Lakes and streams, cool and refreshing, provide fishing areas made possible in part by the surrounding vegetation.

The aesthetic value of Arizona's vegetation is attested to in part by the number of picnickers and campers. In the winter many parties can be found coming to the warm sunny desert; in the summer the desert dwellers move to the cool shaded forests of the mountain areas.

Tourists are also indicators, in part, of the value of the vegetation. Arizona is well-endowed with national parks and monuments. Two of the monuments have been established exclusively for the vegetation they contain. Saguaro National Monument represents many species of desert vegetation including a magnificent stand of the giant cactus. The saguaro, more than any other single plant, represents Arizona and the desert in the minds of most people. It symbolizes sun and warmth to people of cooler climes and is probably Arizona's best advertisement. Organ Pipe Cactus National Monument likewise contains an outstanding display of desert vegetation, including the only abundant stand of organ pipe and senita cacti in the United States. Both of these attract many tourists each year. Grand Canyon National Park and Chiricahua National Monument were established because of their topographic features, but each has a vegetation of considerable interest to the visitor.

Cities and counties have also established parks and recreation areas that exploit the natural vegetation to attract visitors. Tucson Mountain Park has an outstanding example of desert vegetation, and the Arizona-Sonora Desert Museum has assembled a large collection of plants labelled in detail to enlighten those interested. The Desert Botanical Garden at Papago Park near Phoenix has an outstanding collection of labelled cacti.



— Esther Henderson

Yucca — range plant of the Sonoran desert

The ultimate value of Arizona's vegetation is based on multiple-use principles. One use must be set against another until a balance is reached that will keep nature on a level keel for long periods of time. Only when all factors are seen in proper relationship will the full value of this resource be known.

..... *animals*

THE FAUNA OF ARIZONA, AS ITS FLORA, IS extremely diversified. This diversity results from the extremely wide differences in climate, physiography, and vegetation which occur within the state. Accordingly, there is a large number of different types of animal habitats in Arizona, ranging from those in the hot, arid, low desert such as occurs in southern Yuma County, through rich upland deserts, grasslands, and woodlands to moist and cold high montane and alpine habitats such as those that are found in the San Francisco and White mountains.

In many places these habitats merge so gradually that, as one travels along the highway, it is practically impossible to determine where the dividing line is between two adjacent habitats or life zones. In other areas, particularly where the elevation rises abruptly, the lines between different habitats or zones are quite distinct. In fact, it was in the San Francisco Mountain region of central Arizona that C. Hart Merriam, in 1889, made the first observations of the distinct zones of plant and animal life which he later developed into the Life-Zone System for classifying habitats. This system has been widely used by biologists in North America in treating the distribution and evolution of North American animals and plants.

The fauna of the state is made up of three major elements which may be termed Mexican, Rocky Mountain, and Grassland. In general the Rocky Mountain forms occur at the higher elevations in the northern and central part of the state, and also as isolated populations on various of the higher mountains in the southern part. The Grassland forms occur mainly in the eastern half of the state, both

north and south of the high Mogollon Rim. The highly diversified Mexican forms occur primarily in the southern half of the state and occur at all elevations from desert to over 10,000 feet in the Graham Mountains.

In the recent past man has been an important factor in changing the composition of the fauna and influencing the ranges of the various kinds of animals present in Arizona. With the damming of major (e.g., the Gila and Salt) and minor rivers and the pumping of the groundwater for irrigation, drastic changes have been imposed upon the fauna. The great Gila River whose waters once traversed the entire state of Arizona from New Mexico to California is today dry most of the year throughout much of its length. Such losses of Arizona's heritage affect not only such forms as fish and beaver but all kinds of animal life, i.e., invertebrates, fishes, amphibians, reptiles, birds, and mammals, which depend in some part on the habitats afforded by intermittent or permanent streams.

The large carnivores, such as the wolf and grizzly bear, have been exterminated or extremely reduced in numbers, and many of the large herbivores, such as the antelope, have also been greatly reduced in numbers and in their distribution within the state. Many of the grassland species, much as the prairie dog, have also been greatly reduced in numbers, and at least one, the blacktailed prairie dog, which formerly occurred throughout the southwestern part of the state, seems to have been exterminated.

During the past 100 years, naturalists from all over the world have visited Arizona to study its unique fauna. Many scientists have returned here



— Marvin H. Frost, Jr.

Hairy scorpion, tarantula, centipede — venomous but not extremely dangerous to man

to live and to study arid-lands problems which will take many lifetimes to solve completely.

Invertebrates

Arizona's geographic position, and varied topography and climate have given it one of the most interesting faunas of land invertebrates in the United States, dominated by the arthropods. The phylum Arthropoda, which includes the classes Insecta, Arachnida, Crustacea, and Chilopoda, consists of invertebrate animals with articulated bodies and limbs.

Arizona is visited annually by many zoologists, who sometimes travel for thousands of miles to study animals that are found in this area and nowhere else in the United States. Despite intensive study for some years, kinds previously completely unknown are still being discovered, even in areas that are now urban. Only a few kinds can be included in the brief summary here. An estimated 15–20,000 kinds are known from the state. The kinds included are arranged according to general habitat, since those in the various areas differ greatly from each other. **DESERT ARTHROPODS.** The arthropods that live in the desert have many problems. They are cold-blooded animals of small size and very soon reach the temperature of their immediate environment; if this temperature went too high, they would die. Most of the desert arthropods can be classed as desert-evaders. They spend the day underground, inside plants, or in other places where they are protected from the full impact of the sun. In the hottest areas most are underground. At night they come out, move around, feed, mate, and carry on normal animal functions. An area that appears to be completely free of animal life during the day may become very active at night. A few arthropods, and particularly some of the insects, seem to be better adapted to the desert and are active during the day. Somehow they

keep their body temperatures down, but the way they do it is not well understood. Some have reflecting layers of white hair or other special modifications. A very few are opaque black and one would suppose that these get very hot. *Phodaga alticeps*, a black blister beetle, runs around on the sand in the Yuma area during the hottest time of the day and during the hottest months. It is certainly not evading the heat. Most of the diurnal flying insects observe the siesta, hanging up under leaves or retiring to their burrows around noon and becoming active only in the morning and late afternoon. Even the introduced honeybee stays at home during the hottest part of very hot days.

Perhaps of greatest interest to the person who lives or travels in the desert are the various venomous arthropods found there. They form a distinctive segment of the desert, ranking with the spiny plants and rattlesnakes. They are almost always present but the danger of being hurt by them is not great and reasonable precaution prevents trouble. Of top rank are the scorpions. These are primarily nocturnal animals, related to spiders but placed in a separate order. They have four pairs of walking legs, a pair of slender, crab-like pincers and a long, slender tail, which ends in a stinger. All scorpions are provided with venom and they all will use it if they are disturbed. The normal function of the stinger and the venom is one of getting food since scorpions live by killing insects and other arthropods and devouring them. When the stinger is being brought to use, the abdomen is curved up over the body so that the tip points forward over the head. Most scorpions are quite aggressive and the stinger can be inserted with great accuracy. The old admonition to shake out shoes and clothing in the morning should be observed wherever scorpions are present, and particularly if one has been using an abandoned building as a campsite. Only one group of scorpions has a deadly

venom. This is the genus *Centruroides*. Members of this genus are up to about two and one-half inches long, pale and with slender tails. The stinger has a small spine at its base, on the underside, on the bulbous last abdominal segment. If one is stung by a scorpion of this genus, medical attention should be sought at once. The sting may not be very painful at first but a systemic reaction sets in. It is well to capture the offender, so that it can be identified by the attending physician. Even smashed remains may help him to decide on the proper course of treatment. Some other scorpions are much larger, up to six inches long and dark brown in color. These are relatively harmless. Should scorpions become abundant around a house, they can be controlled by the application of residual insecticides. Particular attention should be paid to woodpiles, the undersides of large stones, trash, etc., because the scorpions return to daytime hiding places there after foraging for food at night. Premises free of piled material rarely are scorpion-infested.

A related group, the solpugids or sun spiders, is almost as universally feared as scorpions, but without reason. These animals are about an inch long, with eight legs and a pair of strong pincers and a stubby abdomen. They are pale in color and often congregate around outside lights, where they run down and eat the insects that are found there. For some reason they are known locally as vinegaroons, a name correctly applied to the harmless whip scorpion of higher elevations.

Spiders are more feared than their actual reputation warrants. Tarantulas are our largest spiders and are often seen along roads in the evening. They live in holes in the ground and come out in search of insects at dusk. The largest individuals are females and they may have a body-length of three inches, with four pairs of rather heavy legs making them look much larger. Most individuals are brown but some have reddish hair that makes them look quite striking. The venom of the tarantula is not dangerous and because of the sluggishness of the beasts there is little chance of one's being bitten. The only truly dangerous spider in the region is the black widow. Females are usually shiny black, with a red-hour-glass marking on the underside of their pea-sized abdomens. Young females, all adult males, and a few adult females have diagonal white markings on the upperside of the abdomen. They spin loose webs of very tough silk in protected places and are very likely to move into houses and out-

buildings, even in urban areas. Spraying with a residual insecticide is effective in their control. Few people are bitten by these spiders, even in areas where they are much more abundant than they are in Arizona. The species is found all the way across southern United States and well into Mexico.

Centipedes, or hundred-leggers, are also venomous, but are not deadly. *Scolopendra heros*, Arizona's largest species, reaches a length of more than six inches and is straw-colored, with the front and hind ends black. Centipedes have the first pair of legs modified into fangs, which lie just under the head. The legs at the end of the body have no venom, though they are usually reputed to have by the layman. Even large centipedes occasionally find their way into houses. They can be controlled by the use of the same insecticides as used against the scorpions and the black widow spider. The venom produces violent pain but the chances of being bitten are not great unless one attempts to pick the centipede up.

The foregoing venomous arthropods have probably received more than their share of popular interest. The person who lives in the desert should be aware of their presence and should know what to do about them. Children should be taught not to turn over logs and stones without looking to see what might be underneath. But their presence should not deter anyone from enjoying the desert with its many beauties and freedom from most of the pesky biting insects he finds in the out-of-doors in many other regions.

There are no truly venomous insects in Arizona, in the sense of those carrying a deadly poison. In fact, most of them have no poison at all. A few people are so sensitive to bee and wasp stings they must avoid them at any cost, but for most the few insects that bite or sting cause little more than minor local pain. Insects are six-legged arthropods that usually have wings in the adult stage. Their immature stages may be very much like the adult, as in grasshoppers, or they may be larvae of very different appearance, as in butterflies, flies, beetles, wasps, etc. The larva transforms to an immobile pupa, from which the adult emerges. Once an insect has reached the adult stage and has wings, it grows no more. A little fly does not develop into a big fly or a little beetle into a big beetle. Some kinds increase in size as the eggs and fat bodies fill out the abdomen but the wings and the rest of the body remain the same. The adults of insects are usually rather short-lived, but their immature stages may last as long as several years.

A great many of the desert insects are nocturnal. This is the case with one of the few distinctively desert forms that actively seeks a blood-meal from man — the cone-nose bug, known locally as Hualapai tiger, Texas bedbug, etc. This insect has sucking mouthparts and is about an inch long in the adult stage. The immature individuals are similar to the adult and live in the burrows of native rodents, especially of the pack rat. They feed on the blood of their hosts. The adults fly around at night and move toward light. If a house in the desert is well-lighted, some of the adults may end up inside, and they then seek out a blood-meal from man, rather than from their normal host. The bite they inflict on a sleeping man is quite painful but the pain does not develop until after the insect has fed. Well-screened houses are rarely invaded and the insects are not often seen far from undisturbed desert areas. However, they do sometimes become a problem in suburban areas around Tucson and Phoenix.

In the same areas a stinging caterpillar sometimes becomes very abundant on palo verde trees. This is the caterpillar of the palo verde buck moth, which reaches a length of about an inch and a half and is covered with numerous branching spines. These spines have poison inside them and are capable of causing painful wounds if one is so unfortunate as to brush against them. The caterpillars develop in later summer, form loose cocoons, pupate, and emerge as gray and white moths with reddish abdomens, in the middle of the winter. The adults mate then and the females lay masses of eggs on palo verde, these hatching into caterpillars the following summer.

Another caterpillar also becomes a problem in similar areas. This one is as much as three inches long, smooth, with a harmless spine on the end of the body. The color varies from green to black, through spots and strips. This is the caterpillar of the white-lined sphinx moth. It feeds on various native relatives of the garden four-o'clock plant. Great numbers may be produced in favorable years and they migrate from their feeding grounds by the thousands, overrunning yards and patios in their way. They eventually dig into the ground, pupate, and emerge as adult moths about two inches long, with narrow wings. These moths are often abundant around lights at night and also may be seen at dusk, hovering over flowers like hummingbirds.

Of the beetles, one of the largest that comes to light is the rhinoceros beetle, up to two inches long,

shiny brown, and heavy-bodied. The males have three blunt horns on the front of the body. The larvae live in rotten wood. Both adults and larvae are harmless. Another large brown beetle, up to three inches long and with long antennae or "feelers" is the adult of the palo verde root-borer. The beetles fly from later afternoon to early evening. The females lay their eggs in holes under palo verde trees and the larvae bore down until they reach roots. In the course of their development they may hollow them out completely. The Mexican palo verde is extremely susceptible to damage, large trees sometimes dying suddenly. The white larvae may be as much as five or six inches long. Active black beetles about an inch long, found running under street lights, are ground beetles. These are protected by a vile-smelling secretion and are known in most areas as "stink bugs." They should not be confused with the stink bugs that damage crops, which are usually green, are much smaller, and have sucking mouth parts. The ground beetles are beneficial, feeding on caterpillars in both adult and larval stages.

The most abundant of the day-flying beetles in the cities is the fig beetle or green June beetle. This insect is heavy-bodied, about an inch long, opaque green with yellow margins above the metallic green below. The adults arrive at just about the time that figs, grapes, peaches, and other fruits are ripening in dooryard plantings. The adults may devour most of the fruit in some areas. Covering with paper bags or cloth is the only practical protection. The larvae live in compost, old manure, etc., and the only permanent way of eliminating the beetles is to get rid of the larval habitat. This is difficult in most urban areas but feasible in commercial plantings of fruit trees and vines.

Of the grasshoppers the desert grasshopper (*Trimerotropis*) is the most abundant. The adults are up to two inches long, grayish with black markings and with the hind wings mostly yellow. Enormous numbers sometimes fly to street lights in early summer. The desert race of the common field cricket often comes to lights also, particularly in the region from Yuma to Phoenix, as well as in the deserts of southern California. This race develops long wings and flies readily. Other races in Arizona have short wings.

Ants are numerous in the desert but two kinds are spectacular. One is the harvester ant group, of which there are several species, varying in color from reddish-brown to black. These large ants have simple

nest openings but clear all vegetation for several feet around them. Their food consists largely of seeds. The visitor who has never encountered stinging ants before is likely to get quite a surprise if he lingers too long close to the nest. The other conspicuous ant is the leaf-cutter ant, which makes large mounds at its nest entrances, often in the form of a hollowed cone. This species cuts green leaves from many plants, carrying them back to the nest, where they are used in raising a fungus, which the ants use as food.

Desert shrubs in bloom may attract a swarming mass of flying insects that are there to obtain nectar and pollen. Many kinds of beetles, flies, bees, wasps, and butterflies may be found on a single bush. In size they are dominated by the huge tarantula-hawk wasps, up to two and one-half inches long and blue black, with black or orange wings. The female stings and paralyzes tarantulas, carries them to a burrow, and lays an egg on each. The tarantula serves as food for her larva. The wasps have a formidable stinger. They are not often really abundant but seem so because they are so large that they form a conspicuous part of the fauna.

GRASSLAND ARTHROPODS. There is a gradual transition from desert to grassland and many of the arthropods of the desert are also found where grass is the dominant plant. But the richer plant cover provides a habitat for additional kinds. The grasshoppers, in particular, are more varied. Several kinds become abundant enough in some years to warrant insecticidal control. Perhaps the showiest grasshopper is the horse lubber, up to two and one-half inches long, heavy-bodied, and black with yellow markings. The wings are too short to be used for flying and the hind wings are mostly pink. These grasshoppers and the much drabber plains lubber are sometimes seen in number along roads. While many kinds of grasshoppers damage the range, some of them are really beneficial, since they eat not grass but other plants that are not desirable on the range. For this reason careful checks are made of the species present before any control measures are started, even in outbreak years.

Among the more abundant beetles of the grassland are certain of the blister beetles. Several kinds are usually abundant. These are tied in with grasshoppers rather directly. The young larvae of the beetles seek out the egg-pods of the grasshoppers, which are laid in the ground. There one larvae soon eats up all the eggs in one pod. Then it withdraws from the egg-pod, goes into a resting stage, and

emerges as a beetle the following year. Blister beetles and certain flies do such an effective job of destroying grasshopper eggs that outbreaks are infrequent. The adult blister beetles sometimes cause damage themselves, particularly in cultivated areas, but they must be counted as beneficial on the range.

OAK-ZONE ARTHROPODS. Some of the most unusual insects in Arizona are found principally or entirely in the oak zone. Entomologists who visit the state usually spend much of their time in the lower canyons in this zone, and such places as Ramsey, Madera, and Oak Creek canyons have become famous for their insect fauna. The oak zone is more or less continuous with a similar one in northwestern Mexico but is much more accessible in Arizona than it is there. Many insects in the oak zone are known in the United States only from Arizona. The richest portion extends from Cochise and Santa Cruz counties northwestward along the Mogollon Rim.

Butterflies, moths, and beetles make up a large portion of this interesting fauna, depending on the varied flora for their food supply. The climate is not as extreme as it is on the desert, and most of the insects have no special adaptations to withstand intense heat. Very few of them would be classed as pests, for the simple reason that there are few cultivated or valuable wild plants in this zone. One of the very few poisonous arthropods found here is the puss caterpillar. This is about an inch in length when full-sized, brown, and very soft-looking. Under the soft covering of hairs there are some erect poison spines, which stick into the hands of the person who handles them, causing intense pain. The caterpillar is most likely to be found on oaks. It makes a tight cocoon, which opens by a sort of lid at one end when the adult moth emerges.

Among the beetles of the oak zone, several kinds of scarabs are especially noteworthy. The most famous is *Plusiotis gloriosa*, a pale green beetle about an inch long, with metallic silver stripes. The adults are most often seen around lights at night but apparently feed mainly on juniper and have been seen covering single trees to produce a summer Christmas tree without equal. The larvae live underground. A related species, *Plusiotis beyeri*, is slightly larger and pale green with lavender legs. Both species are avidly sought by amateur collectors.

Of the arthropoda other than insects, perhaps the best known is the whip scorpion. This animal is up to three inches long, with a heavy brown body and extremely slender, whip-like tail. Because it

looks something like a scorpion, it is almost universally feared. It is harmless. A strong vinegar-like odor gives it the local name of vinegaroon, a name indiscriminately applied also to the solpugids or sun spiders and to one wingless subterranean relative of grasshoppers. Whip scorpions are much more abundant in the area to the east of Arizona but they have been found in most of the southeastern mountains in this state.

CONIFEROUS FOREST ARTHROPODS. At higher elevations, at least wherever moisture is adequate, the coniferous forest is dominant. The arthropods associated with it are mostly different from those found at lower elevations, and most of them are the same as the ones found in the Rocky Mountains and even in southern Canada and the north-eastern United States. Arizona shares with the Rockies a number of kinds that attack standing trees either by burrowing under the bark or in the wood or by stripping the tree of its foliage. A caterpillar, the Great Basin tent caterpillar, often defoliates cottonwoods and aspens in this zone. The insects that damage forest trees are capable of causing great loss in marketable wood products and are under constant scrutiny. Outbreaks are often treated chemically.

Aside from the tree-killing or defoliating forest pests, which are conspicuous because of the damage they cause, the most obvious single kind of insect in the mountains is the convergent lady beetle. Great numbers of this small black and orange beetle congregate on certain peaks every summer. The areas covered are so uniform that one might think that the beetles were permanent residents. They are not, however. For some reason, generation after generation of beetles select the same spots. The beetles breed in the lowlands, where they are important predators on aphids or plant lice. In early summer, part of them move to the mountains and remain there the rest of the summer and the following winter, leaving again the following spring.

The permanent streams of the higher elevations have a diverse aquatic insect fauna that is quite different from that of the intermittent streams and ponds lower down, and from that of the Colorado River. As a source of food for fish, this fauna has some indirect economic significance.

Of particular biological interest are the populations of *Scaphinotus*, a group of flightless, snail-eating ground beetles. The populations on the isolated mountain ranges of southeastern Arizona are mostly different from each other, the differences being great

enough that they are classed as separate species. They seem to have evolved in these mountains from an ancient stock, which must have been able to get from mountain to mountain at sometime in the past when the climate was more favorable for forests in the lowlands.

SUMMARY. The arthropods of the several climatic and vegetational zones of Arizona are mostly quite different from each other. Those of the desert are largely nocturnal and some of the diurnal ones have special adaptations to reflect the strong sunlight. Most of the kinds that are provided with venom are restricted to the desert. In the oak zone more kinds are diurnal and there is great diversity of kinds, many being shared with similar areas in northwestern Mexico but not with the rest of the United States. In the zone of the coniferous forest most of the arthropods are like those of the Rocky Mountains and other forested areas in northern North America.

Vertebrates

The vertebrate animals occurring in the state of Arizona fall into the five major vertebrate classes, namely, the fishes, amphibians, reptiles, birds, and mammals.

FISHES. Of the total of sixty-one species of fish now inhabiting Arizona waters, twenty-eight of them are natives, and thirty-three of them are introduced species. The introductions from other states include, in addition to game species, several small bait fish which are mostly minnows and large rough fish which are mainly carp.

A single native game fish, the Arizona native trout (*Salmo gilae*) occurs in the headwaters of the Gila River. It has now hybridized in large part with the planted rainbow trout. This beautiful yellow-golden native trout reaches a length of about sixteen inches and a weight of about two pounds. It remains in pure form in the headwaters of Eagle Creek, in Greenlee County, which is a tributary of the Gila River.

Arizona's waters are today well-stocked with trout and warm water sport fishes including panfish and catfish. The primary warm water fishing areas are rivers and lakes in the central part of the state from the Colorado River on the west across the state to Lyman Reservoir in Greenlee County on the east. The warm water game fishes are channel catfish, yellow bass (or striped bass), smallmouth bass, largemouth bass, green sunfish, bluegill, white crappie, black crappie, and yellow perch.

The primary trout fishing waters are in the central and northern parts of the state from the Colorado River on the west and Grand Canyon on the north to Coolidge Dam on the Gila River at the south and eastward to the Blue River. In addition to the Arizona native trout there are four principal introduced trout species, as follows: rainbow trout, brown trout, cutthroat trout and eastern brook trout.

While it may be a surprising fact, it is nonetheless true that Arizona has a remarkable and highly diversified native fish fauna as a recreational and scientifically important part of its heritage. Moreover, the native Arizona fishes are among the most interesting found in any of our states. Some are rare and much sought-after, others are isolated relics also of scientific importance, and others are of value because of their interesting peculiarities.

One of Arizona's fishes is among the world's largest minnows. This is the Colorado River Squawfish (*Ptychocheilus lucius*) which reaches a length of approximately 5 feet and a weight of about 100 pounds. By sharp contrast, two other species occurring in Arizona are among the smallest of North American fishes. These are the Gila Topminnow (*Poeciliopsis occidentalis*) which is a live-bearer from one to two inches in length, and the Desert Pupfish (*Cyprinodon macularius*) which reaches a length of from two to three inches.

The Colorado River that courses through the Grand Canyon of Arizona is the home of several remarkable native species. For example, in addition to the 100 pound Squawfish there occur two striking hump-backed species. One is a huge hump-backed sucker (*Xyrauchen texanus*) and the other is a large hump-backed minnow (*Gila cypha*). The adaptive significance of humpbackedness in fishes is unknown.

In the Colorado, Salt, Gila, and Verde rivers, and in other rivers and streams in many parts of the state there occurs the "Verde trout" or "Gila trout" which is a large minnow also known as the Bonytail (*Gila robusta*). This native species reaches a length of sixteen inches and a weight of about two pounds. It readily takes a fly and superficially resembles, at least to some, a trout. While not officially considered a game fish and considerably bony to eat, it is a hardy native that can be fun to catch.

While Arizona's heritage includes a native fish fauna of immense interest and scientific importance, it is inevitable that we must also record that this fauna is rapidly disappearing.

AMPHIBIANS. In Arizona, as in other states, the

amphibians are represented by salamanders, frogs, and toads. The salamanders, however, are represented by only a single widespread species, the tiger salamander (*Ambystoma tigrinum*). It is common in northern Arizona where it is represented by two subspecies, the Utah tiger salamander (*Ambystoma tigrinum utahense*) and the Arizona tiger salamander (*Ambystoma tigrinum nebulosum*). In southern Arizona the salamander is of only infrequent occurrence south of the Gila River; here the subspecies is the Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*).

In Arizona, as elsewhere, the greenish gilled larvae called water dogs or mud puppies are sold for bait-fishing and prove an excellent bass bait. Unfortunately, such activity leads to accidental mixings of population and is, of course, detrimental to the study of the natural distribution and geographic variation of the tiger salamander.

There are nineteen species of frogs and toads in Arizona. One of these, the bullfrog (*Rana catesbeiana*) is an introduced species from the southeastern United States. It is now the largest western frog, reaching a body-length of eight inches.

The majority of the remaining eighteen species are primarily Mexican in distribution. Several are grassland species. Some of the toads (*Bufo*, *Scaphiopus*) are especially well-adapted amphibians for life in open, semi-arid lands, while most of the frogs (*Rana*, *Pseudacris*, *Hyla*, *Pternohyla*) are more restricted to the nearness of permanent or semi-permanent streams and/or ponds.

Some species, notably the spadefoot toads (*Scaphiopus*), begin their seasonal activity with the onset of summer rains in July. They virtually "explode" out of the ground at this time and several hundred males and females may constitute the breeding congregation at a single temporary, rain-formed pond.

The Colorado River toad (*Bufo alvarius*) of southern Arizona and northern Mexico is the largest western toad and reaches a body-length of about six inches. It is also our most poisonous species. While the skin and skin secretions of most frogs and toads are poisonous to some degree, that of the Colorado River toad is especially toxic and has proved lethal to small dogs which have mouthed it.

Taken as a whole, the amphibian component of Arizona's fauna is neither large in number of species nor is it particularly well known. During the summer-rainfall period (July-September), however, frogs and



— Howard K. Gloyd

The Gila monster (right) — the only venomous lizard in the U. S. Like the harmless horned lizard or “toad,” he avoids encounters with humans whenever possible

toads are often found in great abundance. The species which do occur here are remarkably well adapted for life in some of the harshest environments occupied by amphibians in North America. With respect to these animals, scientists would like to know more about the mechanisms of the adaptations that permit their successful life.

REPTILES. Arizona is a paradise for herpetologists and other students of reptilian biology. The state’s fauna includes forty-five species of snakes, thirty-seven species of lizards, and five species of turtles.

The turtles include the well-known desert tortoise (*Gopherus agassizi*) which is strictly land-living, the lesser-known box turtle (*Terrapene ornata*) of the grassland, and two mud turtles (*Kinosternon sonoriense* and *Kinosternon flavescens*), all of which are semi-aquatic, and the introduced soft-shelled turtle (*Trionyx ferox*) from the eastern United States. The last is strictly aquatic except for the moment of egg-laying on stream and river banks.

Among the lizards, one of the best-known but poorly understood is the Gila monster (*Heloderma suspectum*). *Heloderma* is the only poisonous lizard in the United States and this genus includes one other equally poisonous lizard, the Mexican beaded lizard (*Heloderma horridum*). The venom of the Gila monster is but mildly toxic compared to that of deadly spiders, scorpions, rattlesnakes, and coral snakes. In fact, it remains questionable that the bite of a Gila monster alone can kill a healthy human being. While the animal is potentially dangerous to man, its deadliness is greatly overrated. When confronted by man the Gila monster’s only desire is to escape and be left alone.

The Gila monster also occurs in extreme south-

western Utah, extreme southwestern New Mexico, and in Sonora, Mexico. Two other lizards are confused with the Gila monster. The adult Banded Gecko (*Coleonyx variegatus*) of the desert reaches a length of three inches and is thought by many people to be a baby Gila monster. The chuckwalla (*Sauromalus obesus*) is a large, rock-dwelling lizard reaching a length of eight inches, and this harmless desert species is often mistaken for an adult Gila monster.

Arizona is the headquarters in the United States for horned lizards (*Phrynosoma*) (horny toads). Six of the seven species of the United States occur here. Five of the six are desert and/or grassland species. One (the short-horned lizard) is primarily a mountain species, extends to 10,000 feet elevation, and bears its young alive as an adaptation to the colder climate in which it lives.

Many other kinds of lizards are adapted to desert habitats as varied as shifting dune sand (e.g., fringe-toed lizard), desert shrubs and trees (e.g., brush and tree lizards), and rocky hills (e.g., collared lizard). Others live in the grasslands of eastern Arizona (e.g., prairie lizard, little striped whiptail), and some live in woodlands and forests (e.g., plateau lizard, alligator lizard, plateau whiptail).

In addition to the banded gecko (*Coleonyx*) two night-lizards (*Xantusia*) are also nocturnal species. During the heat of the summer the Gila monster is also frequently active at night. Most lizards, however, are diurnal and all but the Gila monster are harmless. None should be needlessly destroyed. Most are “insect feeders” and include such animals as grasshoppers, spiders, scorpions, and centipedes in their diets. The chuckwalla (*Sauromalus*) and the desert



— Howard K. Gloyd

Chuckwalla — harmless, plant-eating lizard

iguana (*Dipsosaurus*) are vegetarians. The Gila monster is a carnivore and eats birds and bird eggs, mammals, and lizards.

In Arizona, the horned lizards and the Gila monster are protected by law. Arizona is the headquarters in the United States for rattlesnakes (*Crotalus*) just as it is for horned lizards. Eleven species of rattlesnakes occur in the state and when the subspecies (races of some of these species) are also counted the total of kinds of rattlesnakes is seventeen. They occur from 100 feet in elevation (Yuma County) to over 10,000 feet elevation in the Graham Mountains of Graham County. They occur almost everywhere in Arizona, from shifting desert sands to high coniferous forest habitats. All of the rattlesnakes are potentially dangerous to man from the time that the small snakes are born.

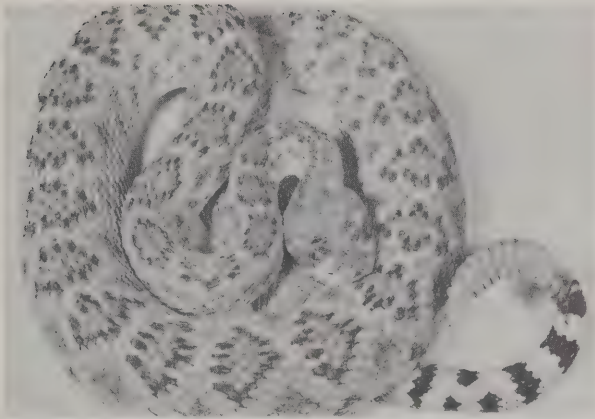
One other kind of snake that is potentially dangerous to man occurs in Arizona. This is the Sonoran coral snake (*Micruroides eurythanthus*). While containing a lethal neurotoxic venom for small animals, this small snake of a maximum twenty-inch length has not been known to bite human beings even when

it has been carelessly picked up and handled. It occurs in the southern half of Arizona where several other small, brightly-colored snakes are frequently confused with it. The Sonoran coral snake has a black snout which readily distinguishes it from the harmless species.

In addition to the rattlesnakes and coral snake, there are four other poisonous kinds of snakes in Arizona, none of which is dangerous to man. These are the lyre snake (*Trimorphodon*), the night snake (*Hypsiglena*), the vine snake (*Oxybelis*), and the blackheaded snake (*Tantilla*). Their distribution is primarily in the southern half of the state.

A true member of the boa family occurs in Arizona. This is the desert boa (*Lichanura*), a small group of species and subspecies which occurs in the Sonoran and Mohave Deserts of Arizona, Sonora, California, and Baja California.

The snakes of the Southwest are highly diversified and, as in the case of the lizards, those occurring in Arizona are found primarily either in the desert, in grassland, or in woodland and forest habitats. The bull snake (*Pituophis*) is an example of a species that



— Howard K. Gloyd

Rattlesnake (left) and Sonoran coral snake — the only Arizona snakes potentially dangerous to man. The diamond-back is one of 11 rattler species in Arizona

lives in all of these situations rather than being more or less restricted to only one or two of them.

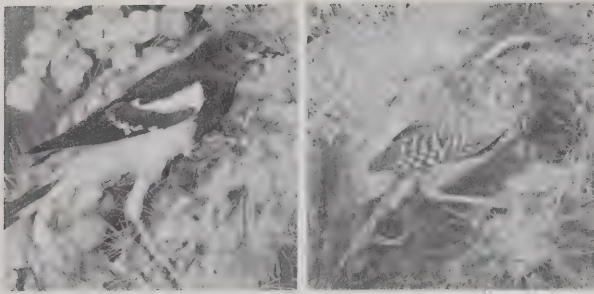
Snake habits are as diversified as their habitats. The diversity of environments in Arizona has led to a great number of different ways in which reptiles live. There are burrowers, climbers, racers, worm-like crawlers, and sidewinders. There are bird and mammal eaters, and lizard eaters. Some lay eggs and others bear living young (rattlesnakes and garter snakes). The males of some species fight one another. More is unknown than is actually known. The study of Arizona's herpetofauna has little more than just begun.

GAME BIRDS. Arizona's largest resident game bird is the Merriam wild turkey (*Meleagris gallopavo merriami*). Wild turkeys probably once inhabited all of the higher country in Arizona including the desert mountain ranges and, according to early newspaper accounts, were once common in the valleys of the San Pedro River and Santa Cruz River of southern Arizona. At an early date the wild turkey disappeared from the southern desert mountain ranges and from these river valleys. He continued to persist in the pine and spruce forests of central and northern Arizona, however, and today, under careful protection and management, has been restored to abundance. The depleted southern desert mountain ranges have been repopulated with turkeys from the more northern areas by transplanting operations of the Arizona Game and Fish Department. Today these transplanted populations are thriving in the Santa Catalina, Chiricahua, Graham, and the Huachuca mountains.

In the higher country the turkey is migratory,

going to the spruce and pine forests to spend the summer and retreating to lower country with the first cold weather and storms, about October 1. These birds are highly gregarious and seldom are they found in small groups. The nesting season begins in May and lasts into August. Normally from eight to twelve eggs are laid in well-concealed nests. After an incubation period of about twenty-eight days, the young, referred to as poults, are hatched.

Five species of quail were once native inhabitants of Arizona. Two of these, the Benson's quail and the masked bobwhite are now extinct. Of the three remaining, the most abundant today is the Gambel's quail (*Lophortyx gambelii*). This bird inhabits most of Arizona below 4,000 feet elevation. His favorite haunts are brushy arroyos, the timbered bottomlands, and the chaparral areas. During most of the year he is gregarious, living in large coveys. Each year in March, however, the whistling of lone cocks signals the beginning of the nesting season. Pairs break away from the coveys, and for the nesting season monogamy is the rule. The female lays her eggs, usually numbering twelve to fifteen, in well-concealed places. After an incubation period of twenty-three days, the young are hatched. From the first few hours they are able to run about, and the male joins the mother and young. Many times, however, nests are destroyed, and new attempts at re-nesting are necessary before a brood is hatched. In the fall the covey is again the rule. During very dry years, few young are hatched and sometimes during extreme drought conditions the birds remain in coveys and do not form pairs. The annual production of young birds varies greatly between years. In years



— Lewis Wayne Walker

Scott's oriole, and the cholla-dwelling cactus wren, the state bird of Arizona

of high winter rainfall and abundant green vegetation, large numbers of young are hatched. These quail, like all ground-nesting birds, have many natural enemies and their own lives are short. About 60 percent of all quail alive in October die of natural causes before another year has passed. A very few of these quail live more than four years.

The Scaled quail (*Callipepla squamata pallida*) inhabits more open country than the Gambel quail. This gray bird is slightly larger than the Gambel quail. It moves about in coveys and has a similar chronology of nesting, though it is most abundant in Cochise County but is also present in parts of Pinal and Santa Cruz counties. It is considered a very fine game bird, but it is not pursued by hunters to the extent that the Gambel quail is.

The third species of quail now living in Arizona is the Mearn's quail (*Cyrtonyx montezumae mearnsi*). It is sometimes called the fool's quail because of its apparent lack of fear. This quail inhabits the live oak areas where openings with high grasses are dominant. Its numbers vary over the range and it is abundant only in years of good rainfall on grassy areas.

There are many migratory species in addition to the residential game birds that inhabit Arizona. Of the migratory game species the doves are the most important. Among the doves there are five native to Arizona: the mourning dove, the white-winged dove, the band-tailed pigeon, the Inca dove, and the Mexican ground dove. The first three of these can be considered game birds while the last two are non-game species.

By far the most abundant of these is the mourning dove which is well-known to everyone. In Arizona it is a year-round resident but must be classed as a migratory bird because the wintering birds represent different populations than the nesting birds. These birds arrive in Arizona in late fall and

leave in the spring. Their nesting areas are far to the north in the western United States and southern Canada.

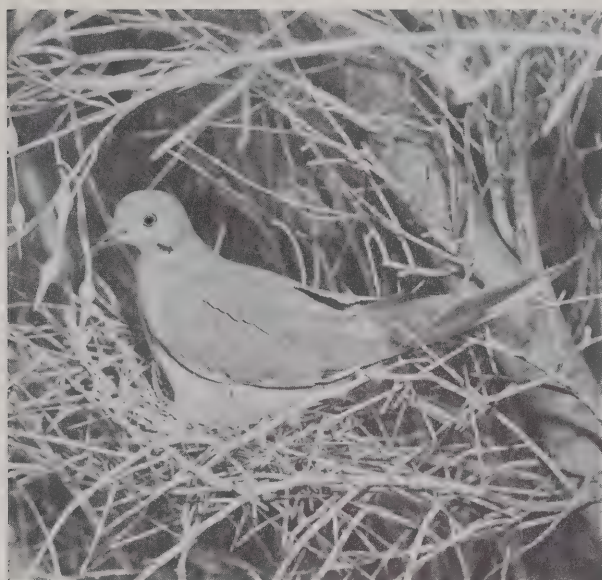
The larger white-winged dove is also hunted extensively in Arizona at waterholes and near grain fields. This dove, however, is in Arizona for only a short period each year. Very rarely does one see a white-winged dove in Arizona after October 1. Arriving from Mexico about the last week in April, the white-winged dove begins its first southward movement out of the state about the third week in August, and only a few remain as late as October 1. Its nesting habits are quite similar to those of the mourning dove. Its nest is also a flimsy structure of twigs but this species is generally not as widely scattered over the country as is the mourning dove. It seems to prefer areas such as the heavy mesquite bosques, citrus groves, salt cedar thickets, and palo verde trees as nesting sites. The destruction of salt cedar and mesquite thickets has reduced the nesting cover of this bird.

The white-winged dove does not nest in any state north of Arizona, and even here its range covers not more than about one-half of the state. It is largely restricted to the lower desert, the river bottoms, and the agricultural lands.

The white-winged dove is a favorite game bird of hunters. It is generally favored over the mourning dove because of its larger size. The methods and places for hunting the white-winged and the mourning dove are similar, and generally the two are taken together. The biggest difference between the two is the very short time that the white-winged dove is available to hunters. Dove-hunting season in Arizona begins on September 1. By this date, however, many of the white-wings have migrated from the state.

One of Arizona's most interesting game birds is the band-tailed pigeon. This bird nests in the high pine, fir, and spruce forests, and piñon areas. The nests are located on the lower branches of trees about twenty feet above the ground. The usual number of eggs in the nest is one and, occasionally, two. Both sexes help incubate the eggs. A wide variety of seeds and fruits comprise the diet of the band-tailed pigeon. In late summer it is gregarious and bands together in great flocks, which dwell in the canyons and live-oak areas where acorns are abundant. During this period the band-tailed pigeon is more frequently seen by travelers than in the summer.

MAMMALS. In all, a total of 290 different kinds (species and subspecies) of mammals are known in



— Lewis Wayne Walker

White-winged dove — warm weather visitor to Arizona, and Palmer thrasher feeding young

Arizona. These represent 135 species belonging to sixty-three different genera, twenty-three different families and seven different orders.

The marsupials (Order Marsupialia) are represented in Arizona by a single species, the virginia opossum (*Didelphis marsupialis*), and this species is extremely rare in the state. At least part of the opossums that exist in the state today result from the release of individuals brought into Arizona from the midwest and the east, and all may be the result of such introductions.

The insectivores (Order Insectivora) are represented in Arizona by only five species, all shrews. Moles, so evident in certain other parts of the United States, are almost completely absent from our fauna. In general, shrews are restricted to the higher mountainous areas, but one species, the desert shrew (*Notiosorex crawfordi*), is widely distributed at lower elevations in the state. Individuals of this species have even taken up residence along the Colorado River near Yuma, an unusual habitat for any shrew.

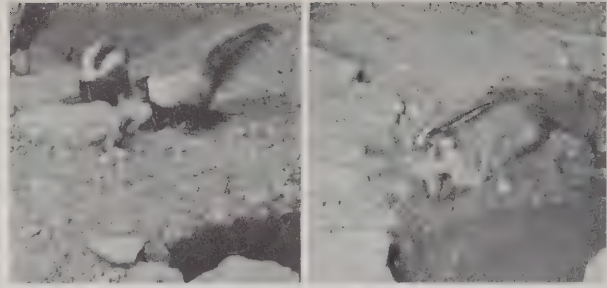
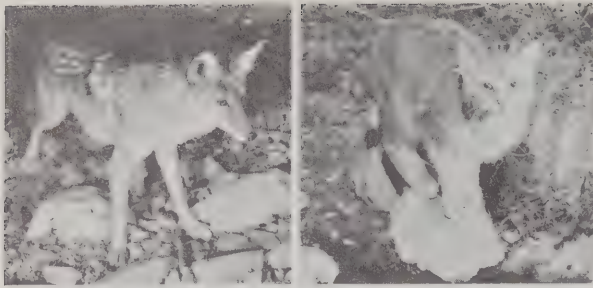
The bats (Order Chiroptera) represented by twenty-seven species of fourteen different genera, are much more common and diverse than in most parts of the United States. Some species, such as the Mexican freetailed bat (*Tadarida brasiliensis*) congregate during the summer months, in maternity colonies estimated to contain as many as twenty million individuals.

The rabbits and hares (Order Lagomorpha) are

some of the most common and best-known forms of wildlife in the state. Arizona has three different species of cottontail rabbit and two species of jackrabbits.

One species of jackrabbit, the California jackrabbit (*Lepus californica*) is found in almost every part of the state. The Allen's jackrabbit (*Lepus alleni*) is found only in isolated areas in southern Arizona. In many places the two are found together. They differ considerably in appearance. The California jackrabbit is predominantly gray while the Allen's jackrabbit has very conspicuous white patches on the rump. Both are rather prolific, bearing several litters of young per year. Their food consists of a great variety of grasses and other green vegetation. At times of great abundance these animals do great damage to field crops in Arizona, especially to alfalfa, grain crops, and gardens.

The most abundant tree squirrel in Arizona is the Abert's squirrel (*Sciurius aberti aberti*). This is the large gray squirrel with the tassel-ears which travelers see in all of the pine country of northern and central Arizona. North of the Grand Canyon in the spruce and pine forest of the Kaibab Plateau is another large, gray, tassel-eared squirrel. This is the Kaibab squirrel, which is now considered not a separate species, but only a sub-species of the same group to which the Abert's squirrel belongs. His habits are very similar to the typical Abert's but rather than having white undersides, he is black along all ventral



— Arizona-Sonora Desert Waterhole

Coyote, bobcat, striped skunk, and badger — carnivores still common in the state

parts. The Abert's squirrel has a black tail while the Kaibab squirrel has a white tail.

The Abert's squirrel is the only Arizona squirrel that is considered a game animal. All of the tree squirrels are protected by law but each year there are open hunting seasons on the Abert. There are two other less common large tree squirrels in Arizona — the Apache fox squirrel, *Sciurus apache*, and the Arizona gray squirrel *Sciurus arizonicus*. The first of these is very similar in appearance to the large eastern fox squirrel and is found in Arizona only in the Chiricahua Mountains. The Arizona gray squirrel occurs in the wooded mountain canyons of most southern Arizona mountain ranges. Neither of these squirrels is very abundant and travelers seldom see either one. No detailed studies of these animals have been made, and why their numbers remain low is not known.

The rodents (Order Rodentia) are probably the most numerous and diverse of all of the mammalian groups in the state. This order contains seventy species, representing twenty-two different genera and eight different families. Some of the more obvious kinds are tree squirrels, ground squirrels, chipmunks, beaver, and muskrat. The nocturnal kangaroo rats are also widely known, as are the wood rats or pack rats.

The carnivores (Order Carnivora) are represented by twenty-two species of sixteen genera and five different families. In the dog family (Family Canidae) the coyotes and gray foxes are still common; the swift fox is becoming relatively rare, and the wolf is now almost extinct although a few wolves are still seen in some of the more remote parts of the state each year.

In the bear family (Family Ursidae) Arizona once had two native species, the black bear (*Euarctos americanus*) and the grizzly bear (*Ursus horribilis*). The grizzly bear is now entirely gone from Arizona.

Just how extensive his early range was will never be known. He was probably never abundant. According to Bill Casto, an early government hunter, the last grizzly bear to be killed in Arizona was taken on Horton Creek in the White Mountains by Ben Lilly in the spring of 1916.

The black bear is still common in Arizona and is protected by the game laws. Only a few are present today in the southeastern mountain ranges — the Chiricahuas, the Huachuclas, the Rincons, the Santa Catalinas, the Santa Ritas, and a few other isolated ranges. In some of these areas it is illegal at any time to kill a black bear. In the Graham Mountains, and the parts of Arizona north of the Mogollon Rim, especially in the White Mountains, larger numbers are present and are still legal game for properly licensed hunters under regular open seasons.

In the raccoon family (Family Procyonidae) Arizona has the raccoon, the coati-mundi, and the ringtailed cat. In the Family Mustelidae are skunks of four different species, weasel, badger, otter rarely, and at least formerly, the black-footed ferret. In the cat family (Felidae) the bobcat is still common throughout the state. The mountain lion still occurs regularly in remote regions, and occasional reports of other species, such as the ocelot and margay cat, still occur.

The Order Artiodactyla, with six species of five different genera and four different families, includes the large game mammals of the state. These are: Family Tayassuidae — the javelina or "wild pig," Family Antilocapridae — the pronghorn antelope; Family Cervidae — the elk and two species of deer; and Family Bovidae — the bighorn sheep.

The story of Arizona's antelope herds, like that of elk, is a tale of early depletion and a later spectacular recovery under management. When the first white settlers came to Arizona much of the open grassy country had large herds of antelope, not only

in the north and central parts of the states where the largest herds are found today, but also in southern Arizona. Some mammalogists have recognized three separate sub-species as originally occurring in the state, one in the north and central, one in the extreme southeast, and another in the southwestern corner. The one in the southwestern part of the state — *Antilocapra americana* — is occasionally seen on the Cabeza Prieta Game Range near Ajo and in surrounding country near the Mexico boundary. The antelope generally inhabits open, grassy country. However, in Arizona travelers will often find herds of antelope in fairly heavily wooded areas in central Arizona. The cienegas and other open areas within these forested regions are heavily used by antelope. Being primarily a social animal, they are found in herds throughout the year except that bucks are often found alone or in small groups in spring. The antelope does, at the time the young are born, generally seek isolation. The breeding season is in August and September. After a gestation period of from 230 to 240 days, the young, referred to as kids, are born in May and June. During the more severe weather in winter all sexes and ages are found together in groups.

Arizona's largest game mammal is the elk or wapiti (*Cervus canadensis*). Native to Arizona, he became extinct about 1900. Our present elk herds are descendants of animals brought from Wyoming in several releases, beginning in 1913.

Little reliable information exists on the early Arizona elk. Only part of one skull is present in America's museums. From the small amount of information, it seems likely that the elk was not abundant in early Arizona. Its range was principally in the White Mountains.

The reintroduction of elk into Arizona and its reestablishment as an important game animal form a thrilling tale in the annals of Arizona game conservation. Today, under careful management and control by the Arizona Game and Fish Department, the elk thrives in Coconino National Forest, Sitgreaves National Forest, Tonto National Forest, and Apache National Forest.

The elk, like the deer, must be annually reduced in numbers so that the herd does not overbalance the available food. Since 1950 the annual harvest of elk by hunters has averaged 877 animals. The kill varies considerably between years, depending mostly upon weather conditions. In times of drought little food is available and fewer calves are born and



— Chuck Abbott

Elk or Wapiti — state's largest game animal

fewer survive. The highest kill since 1950 was 1,693 elk which were taken by hunters in 1951. Naturally many more people want to hunt elk than can be allowed to do so. To manage the herds under this condition, the Arizona Fish and Game Department allows a prescribed number of permits each year and the hunters are selected by a drawing system.

Arizona has two species of deer. The mule deer

(*Odocoileus hemionus*) and the white-tailed deer (*Odocoileus virginianus*). A handsome game animal, the mule deer is found over most of the state. He is abundant in the pine, fir, and spruce forest areas, in the canyons, juniper country, and chaparral areas of central and northern Arizona. In this country he is called the Rocky Mountain mule deer. In the southern part of the state he dwells in the low desert areas and rarely invades the higher forests of pine and spruce. To the local people he is known as the desert mule deer; however, though of the same species, the two mule deer probably represent what are commonly called two different subspecies.

In the high country the Rocky Mountain mule deer is often migratory, coming down from the spruce and pine forests with the first heavy storms of late autumn into the lower canyons, the "juniper breaks," the chaparral areas, the sagebrush flats, and similar places to spend the winter. Here in early December the bucks gather together their harems and the breeding season begins. This breeding season or rut lasts about two months.

With the beginning of the first spring thaws in the mountains, these animals migrate upward in May to their summer homes. Soon after their arrival in the higher country the fawns are born. The normal number of fawns born to a healthy well-fed female is two. When the food is poor or there are too many deer for the food supply, the number of young born is fewer and so are their chances for survival. In about March the bucks shed their antlers and slowly a new set is grown.

In southern Arizona the chronology of events in the life of the desert mule deer lags somewhat behind that of his cousin in northern Arizona. In mating season, period of fawn drop, antler drop, and antler replacement, the southern subspecies lags behind the northern subspecies about three to four weeks.

Arizona's white-tailed deer (*Odocoileus virginianus couesii*), which is a subspecies of the eastern white-tail, is found principally in the higher elevations of the desert mountain ranges of southeastern Arizona. It is found from an elevation of about 3,000 feet to about 10,000 feet above sea level.

The Arizona white-tail is generally considered non-migratory, living the entire year in the same area without altitudinal migrations. Its breeding season begins in mid-December and lasts until February. The young are born in July and August. The period of birth corresponds to the summer

rainy season in this area and is during the period of abundant food.

Though not as small as its tiny and rare relative, the Florida white-tail, this Arizona species is much smaller than its eastern and northern cousin. Hunters with experience with the larger white-tailed deer may be surprised to learn that any Arizona white-tail, field-dressed over 110 to 120 pounds (live weight 140 to 160 pounds) would be considered large, with field-dressed deer over 125 pounds very rare. Though deer weights vary greatly with food conditions, most adult white-tailed bucks shot in Arizona have a field-dressed weight under 100 pounds.

In Arizona one often hears reference to the fan-tailed deer, the little red deer, the Sinaloa deer, and other names which hunters use sometimes to describe what they believe to be a different species of deer. All of these are actually the same little Arizona white-tail. No other kinds of deer except those already mentioned live in Arizona. The differences encountered are only those of size and especially of antler dimensions.

Though Arizona has very large areas of deer range, probably the most famous is the Kaibab Plateau in the Kaibab National Forest in north-western Arizona north of the Grand Canyon. Much of the fame of the Kaibab derives from the large and beautiful antlers which are developed by bucks there, and trophy hunters from many parts of the country come to the Kaibab to hunt. The Kaibab herd has become well known in past years, however, in a less fortunate way. This was because of the heavy mortality of deer from winter starvation which occurred in the herd before World War II.

These tragic, large-scale die-offs of deer are fortunately far less common today because of the greatly improved management of our deer herds. Better management has been achieved partly through better law enforcement and better protection.

Arizona still has thriving populations of the desert bighorn sheep (*Ovis candensis gaillardii*). These are found principally in the dry desert mountain ranges of Yuma and Mohave counties. Small remnants still precariously exist on Pusch Ridge of the Santa Catalina Mountains just a few miles from the city of Tucson, in the Silverbell Mountains about fifty miles west of Tucson, and in other areas.

The chronology of events in the life of the desert bighorn does not coincide with that of other Arizona game animals. These animals do not have seasonal altitudinal migrations as do the northern mule deer



— Tad Nichols

Pronghorn “antelope” — wildlife management has restored Arizona’s depleted herds

and elk, the mating season is in the summer, the gestation period is from 157 to 165 days, and the young are born in January, February, and March.

Investigations in recent years by the Arizona Game and Fish Department and the U.S. Bureau of Sport Fisheries and Wildlife have determined the numbers, needs, and general conditions of these remaining herds. The latter bureau maintains two large refuges for the sheep, the Kofa Desert Game

Range of 660,000 acres of desert near Yuma, and the Cabeza Prieta area of 860,000 acres near Ajo. The principal improvements on the range for desert bighorn sheep have been the development of permanent sources of water. Even in these dry mountain ranges where but three inches of rain fall each year, natural water areas are present. These are few and far between, but man has been able to provide water with tanks, run-off aprons, and catchments.



..... *its government and social services*

The aggregate happiness of society, which is best promoted by the practice of a virtuous policy, is, or ought to be, the end of all government.

GEORGE WASHINGTON

..... *the constitution*

IN THE SENSE OF BASIC LAW AND PRACTICES, the Constitution of the State of Arizona consists not only of the written document which bears the title of constitution, but also important statutes enacted by the legislature, judicial decisions, and customs and conventions. The power of judicial review, one of the most significant of those belonging to the state courts, is based upon judicial precedent, not upon specific provision of the written constitution. Party control of the two houses of the legislature finds its authorization in custom rather than in written article. The written document, however, is the core of the Arizona constitutional system, and other parts of the constitution cannot be in conflict with it.

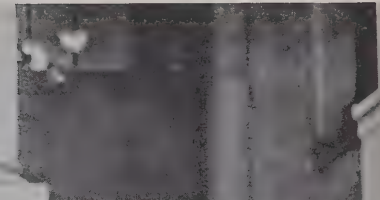
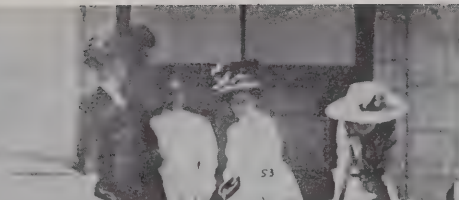
The written constitution drafted in 1910 was a significant step in the orderly development of law and governmental institutions that had been going on in Arizona since the organization of Territorial government in 1863 and in other states for an even longer period. The constitution provided for the continuance, with some changes, of the pattern of local government which had grown up in the Territory, of the system of private and public law, and of numerous other procedures and institutions. The constitution's distinctive quality was derived, however, not from the familiar, but from the innovations, the departures from the customary way of doing things which it contains. These innovations caused friends of the constitution to praise it as "progressive" and critics to label it as "socialistic."

As a consequence of its "liberal" constitution, Arizona has the initiative, referendum, and recall, workers are protected against many of the hazards of employment by the workmen's compensation sys-

tem, the state has a voter-registration system and a direct primary, and a number of municipalities have home-rule charters. In contrast to the constitution, the government in general since 1912 has been conservative, and if anything, has grown more so in recent years, probably as a result of the growing number of Republican voters among newcomers to the state, the conservative temper of the times, and public reaction to the excesses of some segments of organized labor. The conservatism of the government has tended to give the constitution a similar conservative quality, since the character of a constitution is determined to a great extent by the manner in which it is interpreted and applied. However, with the continued urbanization of the state and the diversification of industry, which may weaken some of the traditional clusters of political and economic power, there is some possibility that the contrast between government and written constitution may tend to disappear.

To understand why the Arizona constitution contains a number of "liberal" or "progressive" provisions, in contrast to the conventional constitution framed by New Mexico at approximately the same time, one must examine certain forces at work in the nation at large and in Arizona in the early part of the century. The innovations of the constitution were the product of two forces — the determination of liberal groups within the Territory to create a government which would be more responsive to popular will and which would place various restraints upon the power of the large corporations, and the nation-wide progressive movement, which created a climate of public opinion favorable to the objec-

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- 2 Morris Caldwell, Vice Pres.
- 3 Wm M. Litchell
- 4 Hugh Ingraham
- 5 Jacob M. Hensinger



- 6 Fred J. Galt
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- 8 L. J. Jones
- 9 P. K. Connolly

- 10 John Kane
- 11 A. L. Lynch

- 12 George Fusch
- 13 Charles C. Gierme

- 14 Thos. H. Seery
- 15 C. A. Curtis

- 17 Albert M. Jones
- 18 W. H. Humphrey

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PHOENIX, ARIZ.

MEMBERS ARIZONA CONSTITUTIONAL CONVENTION
Phoenix, October 10 - December 9, 1910

tives of Arizona liberals and which probably contributed to the objectives themselves. The Arizona liberals, although concerned with checking the power of the large corporations were also interested in other changes as well, a fact which is amply supported by numerous sections of the constitution.

The Territory of Arizona, as well as that of New Mexico, was authorized by Congress in the Enabling Act of June 20, 1910, to draft a proposed state constitution. The act fixed the number of convention delegates at 52, directed Territorial officials to apportion the delegates among the counties on the basis of their 1908 voting populations, and appropriated \$100,000 to underwrite the election of delegates, the costs of the convention, and the popular vote on the proposed state constitution.

Organized labor played an important role in the campaign for the election of convention delegates and in the writing of the constitution. Its influence was out of all proportion to its membership, which embraced only a minority of the workers, because its demands coincided with the objectives of the contemporary progressive movement and, what is probably more important, were in the main acceptable to the dominant liberal wing of the Democratic party.

A section of organized labor, led by the Bisbee Miner's Union, organized a labor party at a conference at Phoenix in July, 1910, in an attempt to elect labor delegates to the convention, but disbanded the organization after reaching an understanding with the leaders of the Democratic party. The new party had failed to win the support of all sections of organized labor, and feared, moreover, that its activities might contribute to a Republican victory by splitting up the Democratic vote. In the accord with the Democratic party, labor agreed to disband its party and work for the election of Democratic delegates, while Democratic leaders promised to support labor objectives. George W. P. Hunt, who was to become president of the constitutional convention, is credited with the negotiation of the agreement.

In the campaign for the election of delegates, the initiative, referendum, and recall as proposed provisions of the constitution excited the most controversy. The Democratic county conventions supported these objectives, while the Republican county platforms either ignored or denounced them. During the campaign, however, numerous Republican candidates endorsed direct legislation. In terms which have a contemporary ring, the charge was made

during the election campaign that the initiative, referendum, and recall were designed by the socialists to destroy the American form of government. Democratic platforms also contained proposals for employer's liability, an income tax, direct election of United States senators, and corrupt practices legislation.

Delegates were elected on September 12, 1910, the voters choosing forty-one Democrats and eleven Republicans. A majority of the Democrats was aligned with the progressive wing of the party. The constitutional convention opened on October 10 and closed on December 9, 1910. The Enabling Act had stipulated that members would be paid for every day the convention was in session, up to a total of sixty. Sessions were held in the chamber of the Territorial House of Representatives in Phoenix.

Mr. Hunt, who later became Arizona's first state governor, an office to which he was elected seven times in all, was chosen president of the convention. He is credited with exercising more influence upon the work of the convention than any other delegate. At the time, labor groups regarded Mr. Hunt as a particular friend.

Other delegates whose names are well-known in Arizona include Dr. B. B. Moeur and Sidney Osborn, both of Maricopa County, who became governors of the state. Mitt Simms, a farmer from Graham County, served as secretary of state, state treasurer, and as a member of the State Corporation Commission. Dr. A. M. Tuthill of Graham became Adjutant General and later director of selective service, and Mulford Winsor was named the first land commissioner and later the director of the State Department of Library and Archives, a post he held until his death several years ago. Carlos C. Jacome of Pima County, Morris Goldwater of Yavapai County, and E. A. Tovrea of Cochise County were prominent in the economic life of Arizona, as were Tom Feeney of Cochise County, one of the principal spokesmen at the convention for mining interests, A. C. Baker and Alfred Franklin of Maricopa County, and Jacob Weinberger of Gila County.

The work of the convention was distributed among twenty-four committees, three for "conducting the convention," and twenty-one for "constitution making." Chairmanships went to members of the liberal wing of the Democratic party. A verbatim record of convention proceedings was kept, which today constitutes an invaluable guide to the work of the convention. The record suffers, however,



— Arizona Pioneers' Society

President William Howard Taft signing the Proclamation of Statehood for Arizona

from the failure of the convention to appropriate funds to hire trained stenographers. Numerous speeches made in the course of debate are included in the record. In the preparation of official copies of the verbatim report, speeches were lifted from the stenographic record and sent to members for editing. Many were not returned.

In writing the constitution, the delegates studied not only the institutions and practices of government developed during Territorial days but also various state constitutions. Special attention was paid to the constitutions of Oregon and Oklahoma. As might be expected in a numerous assemblage, the work of the convention was marked by controversy and compromise. The dispute over the recall provision was more heated than that over direct legislation because of the proposal to apply the recall to judges. Conservative delegates, as well as outsiders, warned their colleagues that President Taft was certain to reject the constitution if the recall did not omit the judi-

ary. Some delegates feared that a recall provision which included judicial office might delay statehood indefinitely. This fear was reflected in several of the invocations of Chaplain Crutchfield of the convention, who on the morning of November 28 prayed, "O Lord, we are not willing to believe President Taft will turn down our constitution on account of such a small matter as the Recall, Initiative, and Referendum..."

When the document was drafted and submitted to the delegates for signature, eleven delegates, including one Democrat, refused to sign. The dissidents, doubtless with an eye to posterity, proposed that they be permitted to sign and place the words, "We disapprove" under their names, but the majority rejected the idea. On February 2, 1911, the constitution was referred to the voters, a large majority of whom voted in favor of the document.

The proposed state constitution was acceptable to Congress, but not to President Taft, who, as

predicted because of his opposition to the application of the recall to judges, vetoed the joint resolution which Congress had passed on August 10 providing for the admission of Arizona. In conformity with the suggestions of Congress in its joint resolution of August 21, Arizona amended the constitution on December 12, 1911, to remove judges from the recall, and President Taft on February 14, 1912, proclaimed the admission of Arizona to statehood. The voters of Arizona on November 5, 1912, endorsed an amendment to restore the original wording to the recall provision.

When it went into effect in 1912, the constitution was a relatively short document of approximately 25,000 words. It is still comparatively brief. Similar to other state constitutions, it contains a preamble and a bill of rights; it provides a framework of government based upon the familiar doctrine of separation of powers and its corollary, checks and balances; it embodies provisions dealing with the popular control of government, public finance, education, local government, private corporations, water rights, and labor; and it contains an amending clause.

Although the constitution was in general "liberal" or progressive, in the sense that a number of its provisions represented deviations from traditional institutions and ways, its liberal character did not extend to the legislature and executive articles. The reform movement of the early twentieth century tended to neglect such matters as legislative councils and unicameralism, and apparently did not understand that an efficient, well-organized executive branch was just as essential to good government as honest officials. The merit system was an objective of the general political reform movement of the day, but it was not an issue in Arizona. Serious proposals for reform in these areas were not raised in Arizona until sometime later.

The initiative, referendum, and recall were the best-known, but not the only progressive features of the constitution. Labor regarded others as of equal importance. With respect to the liability of employers for injuries suffered by their employees, the constitution abolished the fellow-servant doctrine of the common law and narrowed the protection offered by the doctrines of contributory negligence and assumption of risk by stating that these defenses in accident cases were questions of fact, subject to jury determination. The legislature was directed to enact employer's liability and workmen's compensation laws. The constitution reserved to workers the

privilege of electing to sue for damages in the event of injury, with the amount involved in the suit, or in any other damage suit, not subject to statutory limitation. Employers were forbidden to require employees, as a condition of employment, to release them from liability for personal injuries received through the negligence of employer or agent.

Blacklists were outlawed by the constitution and the office of state mine inspector was created. The constitution fixed an eight-hour day for employees of state and local government and forbade the employment of children under fourteen during school hours and children under sixteen in underground mines or other hazardous occupations or in work injurious to health or morals.

Sections of the constitution which limit or control the activities and powers of business corporations also indicate the progressive nature of the document. The constitution forbids the enactment of any law granting an irrevocable privilege or franchise, and empowers the legislature, without impairing the obligation of contract, to change or repeal laws pertaining to corporations at any time, and to impose conditions other than those given in the constitution. Municipal corporations cannot grant, extend, or renew a franchise for a term of more than twenty-five years, and action taken is subject to a popular referendum. "Monopolies and trusts shall never be allowed in this State," and business concerns and other associations are forbidden to enter into contracts or other schemes to fix prices, limit output, or regulate the transportation of any product.

The constitution states that the resources of public service corporations, state banks, building and loan associations, trust, insurance, and guaranty companies "shall be at all times liable and subject to the full visitatorial and inquisitorial powers of the State" and gives to the Corporation Commission the power to investigate any corporation whose stock is offered for sale to the public. Corporations are forbidden to contribute money or anything else of value "for the purpose of influencing any election or official action." The Corporation Commission, which developed from the railroad commission of Territorial government, was established to regulate public service corporations.

Although the constitution protects persons accused of crime from compulsory self-incrimination, it does not extend this guarantee to persons "having knowledge or possession of facts that tend to estab-

lish the guilt of any other person or corporation charged with bribery or illegal rebating." A person with such knowledge cannot escape giving testimony or producing evidence on the ground that he might incriminate himself. However, he cannot be prosecuted or penalized because of his testimony or evidence.

Undoubtedly the desire of the liberal majority of the convention delegates to permit the greater taxation of personal and corporate income was an important factor behind the section authorizing the legislature to levy not only uniform income, inheritance, and legacy taxes, but also "graduated income taxes, graduated collateral and direct inheritance taxes, graduated legacy and succession taxes, stamp, registration, production or other specific taxes."

The constitution also included other provisions which were relatively advanced for the times. It authorized the legislature to provide for juries of fewer than twelve in courts not of record, for a verdict by nine or more jurors in civil cases in courts of record, and for waiving a jury in civil cases with the consent of the interested parties. Persons could be brought to trial on criminal charges by information, as well as by the traditional grand jury indictment. Salaries rather than fees were required for all state and county officers and all justices of the peace whose precincts included a city or town. The constitution directed the legislature to enact direct primary and registration laws. The legislature was also directed to adopt rules and enact laws prohibiting the practice of lobbying on the floor of the two houses and further regulating lobbying. The latter part of the injunction has not been heeded. Under the home-rule section of the constitution, cities of more than 3,500 population were given permission to frame, adopt, and amend their own charters rather than to operate on the basis of a ready-made charter written into state law.

The constitution has been changed by formal amendments, statutory elaboration, and judicial decision. Because of the tendency of state courts to construe the powers of the legislature narrowly, the

role of the legislature in constitutional change, while important, has been of a lesser order than that of Congress with respect to the federal Constitution.

Amendments may be proposed to the Arizona constitution by any one of three methods, but ratified by only one method, popular action. The legislature may propose amendments by a majority vote of the members elected to each house and groups of voters may offer them by initiative petition signed by voters equivalent in number to at least 15 percent of the total votes cast for all candidates for governor at the last general election. Amendments may also be put forward by a convention called by the legislature, provided the laws for convoking the convention are first approved by the voters in a referendum election. The last method has not been used to date. If the voters approve, the legislature also may call a convention to revise the constitution or draft a new one. As the methods used to date for proposing amendments have worked satisfactorily, the legislature likely would have revision or a new constitution in mind if it should call a convention.

Ninety-eight amendments had been formally proposed as of the end of 1959 and forty-three adopted. The legislature proposed fifty-nine and groups of voters, using the initiative process, thirty-nine. Thirty of the former and thirteen of the latter became part of the constitution.

Amendments of note since the close of World War II include the so-called "right-to-work amendment" of 1946 which forbids the closed and union shops (although both exist on a *de facto* basis); the amendment of 1949 which excepts city managers from the requirement that persons elected or appointed to state or local office must be qualified electors of the political division of which the office is a part; the amendment of 1950 which replaced biennial regular sessions of the state legislature with annual sessions; and the amendment of 1953 which increased the representation of rural areas in the legislature by giving each county two senators. Before this last amendment became effective, five counties had two senators each, nine had one each.

..... *the executive and legislative branches*

THE CONSTITUTION OF THE STATE OF ARIZONA disperses executive power and responsibility by creating a plural executive consisting of governor, secretary of state, state auditor, treasurer, attorney general, and superintendent of public instruction. These six officials, according to the constitution, make up the executive department; but in reality they head an executive branch consisting of numerous other administrative officers, boards, commissions, and agencies established by statute. The constitution also provides specifically for an elective corporation commission of three members, an elective mine inspector, a state examiner appointed by the governor, and a state board of education and a board of regents which are partly *ex officio* and partly appointive.

In harmony with the theory that divides executive power, the constitution fixes two-year terms for the six officers who head the executive branch. All are eligible for re-election for an indefinite number of terms, with the exception of the treasurer, who cannot "succeed himself . . . for the succeeding two years after the expiration of the term for which he shall have been elected." In view of the scanty discretionary power lodged in the treasurer, this ban upon two consecutive terms seems unrealistic. On the assumption that a longer term would allow state executives to do a better job, proposed amendments to lengthen the terms to four years appeared on the ballot in 1922, 1933, 1946, and 1950, but were rejected by the voters.

Constitutional qualifications are the same for governor and the other five officers. Each must be at least twenty-five years of age, a citizen of the

United States for ten years and of Arizona for five years immediately preceding election, a qualified voter of the state, and proficient in the use of the English language. The attorney general is required by statute to have been eligible for practice before the state Supreme Court during the five-year period immediately before his election. Since most Arizona residents, if they live long enough, are able to meet constitutional requirements, other qualifications, such as political skill, experience, and associates are of at least equal importance.

Aside from resignation, death, or defeat at the polls, the governor and other executive officials may be removed from office by the democratic process of recall or the legislative process of impeachment, with the latter being limited to cases involving "high crimes, misdemeanors, or malfeasance in office . . ." None has been removed by either method. By statute, the legislature has ruled that a vacancy exists in an office when the incumbent has been found guilty of a felony or adjudged insane, or when he has been absent from the state for more than three months without legislative permission, or fails to perform the duties of his office for a period of more than three consecutive months.

In the event of the death, resignation, removal from office, or permanent disability of the governor, the secretary of state, if holding office by election, becomes governor, both in fact and in name. Next in line of succession are the attorney general, state auditor, state treasurer, and superintendent of public instruction.

The governor is by implication the chief executive, although the constitution nowhere uses the title.

As chief executive, he has the nominal responsibility for seeing that laws are administered or enforced, exercising some legislative leadership, performing certain judicial functions, and serving as the social and ceremonial head of state government.

In his capacity as chief administrator, the governor "shall transact all executive business with the officers of the Government, civil and military, and may require information in writing from the officers in the Executive Department upon any subject relating to the duties of their respective offices" and "he shall take care that the laws be faithfully executed." The governor furthermore is directed by law to supervise the official conduct of all executive and ministerial officials, and he is vested with the authority to require any officer or board to make a special report to him. He has some opportunity to influence administration through his appointive power, as he names more than 200 persons to boards, commissions, and other agencies. Senatorial confirmation usually is required. His removal power is much narrower than his appointive power, in cases of appointments for definite terms. He has a fairly free hand, however, in removing officers whom he has appointed for indefinite terms.

In recent years the office of governor has shown some slight tendency to develop into an important center of legislative leadership. The growth of state government as a positive force in the economic and social life of Arizona has contributed to the need for legislative leadership which has not always been met from within the legislature. There is some inclination, moreover, for the people of Arizona to look to the governor for leadership because he, in contrast to members of the legislature, is elected by the voters of the entire state.

The governor has the opportunity to submit a legislative program to the legislature, and to the state at large, when he obeys the constitutional mandate "to communicate, by message, to the Legislature at every session the condition of the state, and recommend such matters as he shall deem expedient." He may veto bills passed by the legislature, which in turn may repass them by a two-thirds majority or, if the bills are emergency measures, three-fourths. In addition, he may veto items of appropriation laws. The governor may call the legislature into special session; and the legislature can consider only the proposals listed by the governor in his call. The governor may supplement his constitutional powers for influencing policy-making by bidding for public

support for his program, or special measures through press conferences and radio and TV addresses and from the public platform. He may use his influence as a party leader, when his party also controls the legislature, and he may employ persuasion and cajolery in informal conferences with legislative leaders.

In his capacity as social and ceremonial head of the state, the governor welcomes distinguished visitors, makes numerous public addresses and appearances, eats hundreds of free meals, proclaims special days and weeks, and officiates at dedication ceremonies for public and private works. Judicial powers of the governor include the granting of reprieves, commutations, and pardons, subject to rules laid down by the legislature, except where treason or impeachment is involved.

The governor of Arizona is essentially a weak chief executive in comparison to the President or to the governors of states which have undergone extensive administrative reorganizations. The constitution disperses executive power among six elective executives, and the governor has little control over the other executives who as elected officers are primarily answerable to the voters. He does not have effective supervisory authority over the numerous boards and commissions, many of whose members have been appointed by his predecessors in office. Even if his administrative authority were greater, he would have great difficulty in directing and coordinating the activities of the executive branch because of the presence of more than 100 separate administrative agencies, the loose, disjointed nature of the administrative structure, his virtual lack of a staff, the absence of definite lines of control and responsibility to tie the administrative structure together, and the non-existence of service-wide management agencies.

His administrative shortcomings have impaired his influence as a legislative leader. With a better organized administrative structure, policy proposals framed by competent specialists in subordinate agencies would as a matter of course be routed upward through the administrative hierarchy to the governor for consideration and possible submission to the legislature. These proposals possibly would carry greater weight in the legislature because of the special knowledge of the administrators who drafted them. The governor today has little more than formal control over the budget document, which is prepared by the state auditor. Obviously, if the governor had more control over the formation

of the budget, which is essentially a program of governmental activities for the coming fiscal year stated in financial terms, he would have infinitely more influence in the law-making process.

The present position of the governor is attributable to a number of factors ranging from theory to accident. The constitution undoubtedly embodies the twin theories that executive power is a necessary evil and ought to be dispersed in the interest of safety, and that there is a definite relation between democracy and the number of elective, executive offices. Accident probably entered the picture in the unplanned growth of administrative agencies.

Proposals to change the office of chief executive range from suggestions for a four-year term to comprehensive plans for the complete overhauling of the administrative structure. Griffenhagen and Associates of Chicago, in their study of state government published in 1949 for a special committee of the state legislature, recommended the creation of a strong governor through the consolidation of the many separate administrative agencies into fifteen major departments, which would be subject to the direction and control of the governor. The governor, the only elective executive officer, would appoint the department heads, who would be answerable to him. Collectively, the department heads would constitute the governor's cabinet. A modern system of personnel management was recommended.

In defense of reorganization, it is said that a strong governor would serve the ends of efficiency by providing the opportunity for better administered state laws, and the ends of democracy by providing for a more responsible executive in whom both power and responsibility are centered. In view of the temper of the legislature and the lack of any strong public sentiment for change, there seems little likelihood of extensive changes in the near future. In the long run, however, reorganization is likely. Demands for improvements undoubtedly will be stimulated by the growing volume, technical difficulty, and increasing costs of state administration.

The Legislature

The primary responsibility for making laws is vested in the state legislature. Like all but one of its counterparts in other states, the Arizona Legislature is bicameral, consisting of the House of Representatives and the Senate. The House of Representatives is limited by the constitution to a maximum of eighty members. The membership is apportioned among the

counties of the state on the basis of the votes cast in the previous election for governor, with each county having at least one. The two major urban counties, Maricopa and Pima, have the preponderance of representation in the House, with thirty-seven and sixteen respectively. To provide for changes in population, reapportionment of representation among counties is required every four years.

Until 1955 the Senate also reflected population differences with five counties having two senators and others only one. In that year, however, the people approved a constitutional amendment giving to each county two senators, making twenty-eight in all. There are no differences in the qualifications for membership in the House and the Senate, each requiring citizenship, minimum age of twenty-five years, residence of three years in Arizona, residence of one year in the county from which elected, and ability to read and write English. The terms of office for both Senate and House are two years.

There is occasional criticism of the existing system of representation, coming particularly from urban areas, on the ground that the Senate gives an inordinate share of political power to rural areas with a small fraction of the population. The system is defended as necessary to protect the minority interests against overwhelming numbers located in the urban communities. Occasionally there are suggestions, such as that made by the AFL-CIO in 1959, that a unicameral system be adopted. Such an alteration would require a constitutional amendment and appears unlikely to meet with approval.

Membership in the state legislature is not considered a full-time occupation. The legislature met biennially before 1950, but in that year a constitutional amendment was adopted providing for annual sessions. The legislators are paid only for the first sixty legislative days, after which they receive only their expenses. At times, the legislature meets well beyond sixty days, as it did in 1956 when the regular session lasted over ninety days. Members are paid \$1800 for each regular session, and \$20 per day for a maximum of twenty days in each special session that may be called. It is necessary, therefore, that the members have some other source of income to supplement their legislative salaries. The members of the present legislature are drawn chiefly from the ranks of businesses of varying kinds, with a liberal admixture of people from farming, ranching, trades, professions, and retired ranks.

The powers of the legislature are very broad,

generally subsumed under what are known as the "police powers" — the power to protect the health, welfare, safety, and morals of the community. The legislature, exclusive of those powers delegated to the national government by the United States Constitution, may enact laws on any matters not proscribed by the Arizona Constitution. The state constitution prohibits the passage of special or local laws relating to the granting of divorce, location of county seats, granting of special privileges to corporations, and numerous other matters. The Declaration of Rights, which is comparable to the Bill of Rights in the federal Constitution, also limits the legislature. Other limitations relate to imposition of property taxes on widows and veterans, and payment of additional compensation to public employees and private contractors.

Although political parties are nowhere mentioned directly in the constitution, it would be impossible to understand the operation of the legislature without an awareness of the important parts they play. The parties are the basis for organizing the legislative chambers and are the means of making the legislative process work.

Arizona is traditionally a Democratic state, and therefore the Democratic party normally obtains a sizable majority of the membership of each house. Presently, there are fifty-five Democrats and twenty-five Republicans in the House of Representatives, and twenty-seven Democrats and one Republican in the Senate. These figures do not, however, portray the actual divisions within the two chambers. In the Senate, for example, the lone Republican is a member of the majority caucus, while several of the Democrats constitute an opposition to the majority bloc. In the House, the minority Democratic members frequently oppose the majority faction of their party, causing the latter often to cooperate more closely with the Republican minority than with the opposition in their own party.

The importance of the party in the operation of the legislature is found in the election of the presiding and other officers, the choice of committee members, and the control over the agenda of the chambers. For clear-cut responsibility, one would expect all party members to support their own leadership. In the election of a Speaker, however, minority Democrats frequently propose their own candidate. The Speaker makes all committee assignments and thus is in a very propitious position to reward those members of the chamber who have given him aid.

The Speaker is also chairman of the Rules Committee which controls access to the floor of bills reported by committees. Failure to obtain clearance from the Rules Committee usually will result in the death of a bill.

In theory and sometimes in fact, the legislature is the "law-making" branch of government. But a large number of the proposals considered by the legislature have their origin elsewhere. The governor is one of the most important sources of bills. Executive agencies are frequent contributors of proposed legislation. Private interest groups and individuals, working with and through their elected representatives, provide a great deal of the grist for the legislative mill.

The committee system is an extremely important element in the legislative process. All bills introduced into either house are referred to committees having jurisdiction over particular subjects, such as public lands, counties, or highways and bridges. These bills are considered in detail by the committees, which may suppress the bills, report favorably or unfavorably, or report without recommendation. Bills may be referred to as many as four different committees, each having the power to dispose of the bills as it wishes. In theory, each house may discharge a committee from further consideration of a bill after a certain period of deliberation, but this procedure is seldom used. The influence of the leadership, however, is sufficiently strong that most bills supported by the leadership are reported out of committees. There are presently twenty-one committees in each house, not all of which have comparable jurisdiction.

The committees, in deliberating, may take testimony and evidence from representatives of executive departments, from private interest groups, representatives, or others interested in the legislation, but are not required to do so, and may conduct such hearings either in public or in executive sessions. Seldom is a verbatim record kept of hearings. The committees rarely make formal written reports to the chambers at the conclusion of their deliberations.

Each house adopts its own rules of procedure, with certain restrictions imposed by the constitution. Normally, after committee consideration, a bill is placed on the calendar and then brought up for debate in the house in question when it is sitting as the Committee of the Whole. At the conclusion of debate and after all amendments have been disposed of, the bill is then brought before the house for final consideration and vote. It is necessary for a majority

to be present to conduct business; every bill must be read in its entirety at least once; votes on final passage must be by roll call; bills may be passed only by the approving vote of a majority of the entire membership of each house. This latter provision means that absentees may count as automatic negative votes when the legislature is closely divided. If attached to legislation is an emergency clause waiving the normal requirement that acts remain inoperative for ninety days after enactment, two-thirds of the entire membership must approve the bill. Frequently the emergency clause is attached to routine legislation in which no emergency in fact exists.

If the two houses fail to agree on all features of a particular bill, the disagreement may be removed by one of the houses accepting the other's views, or by the convening of a conference committee consisting of members of both houses appointed by their respective presiding officers. If the conference committee can resolve the differences, the bills are then returned to each chamber for final passage. Approved bills are then sent to the governor.

The state legislature has availed itself of professional assistance through the Legislative Council established in 1953. The council is composed of the President of the Senate, the Speaker of the House, and five senators and five representatives chosen by them. The council meets periodically and is responsible for legislative research, maintenance of a legislative library, and bill drafting. Professional staff members are employed to provide assistance in these matters. The council has made noteworthy contributions to understanding of legislative problems such as reapportionment of congressional districts and tax exemptions for veterans. The Department of Library and Archives maintains the library facilities for the legislature. Only the House Judiciary Committee, of all the committees in either house, employs its own professional staff.

The legislature has also employed a post auditor responsible for the examination of accounts and financial practices of the administrative agencies of the state. He furnishes the legislature with information regarding the financial condition of the agencies,

for use in considering legislative and appropriation bills.

Article XXII, section 19 of the constitution requires that the legislature pass laws prohibiting lobbying on the floor of either house and further regulating the practice of lobbying. This obligation has not been fulfilled, however, and there is little sentiment for passage of such legislation. Only outright corruption of legislators through vote-buying has been made illegal. Lobbyists engage in considerable activity during each legislative session, many organizations maintaining full-time representation in Phoenix during the session. Their ability to present information and points of view make them potent, though informal participants in the legislative process.

Not all legislative power is lodged in the legislature. The voters, through the initiative and referendum, have reserved to themselves the prerogative of considering legislation the legislature refused to enact, and of reconsidering enactments passed by the legislature. Through the initiative, 10 percent of the qualified electors may, by petition, require to be submitted to the voters, any measure they desire. Fifteen percent may require a constitutional amendment to be submitted. The Secretary of State submits these proposals to the voters after ascertaining the validity of the petitions. In each case, a majority of the votes cast is required for approval. The recent adoption of a three-day waiting period for those wishing to marry, and the change in the name of Arizona State University came through use of the initiative.

Under the referendum procedure, the legislature must refer approved constitutional amendments to the people. It may refer acts or parts of acts to the voters. Five percent of the people voting for governor in the previous election may require to be submitted to the people any acts not carrying the emergency clause. Again, a majority vote is required for passage. If initiated or referred measures receive a majority of the votes cast, but less than a majority of votes from all registered voters, the legislature may amend or repeal such legislation.

..... *the judicial branch*

THE ORGANIC AUTHORITY FOR THE COURT structure of Arizona during Territorial days derived from two acts of Congress: (1) an act passed September 9, 1850, which established the Territory of New Mexico, and (2) an act passed February 24, 1863, which provided a temporary government for the Territory of Arizona.

The first act created a supreme court for New Mexico with common law and chancery powers, a system of inferior courts with limited jurisdiction, judicial districts, certain other accessory provisions, and gave power to the governor to define the districts, assign judges, and to fix terms of court until the legislature might otherwise provide. The Supreme Court was composed of a chief justice and two associate justices of which any two would constitute a quorum.

The act of 1863 was an expediency. It served as the organic law until an Arizona Territorial legislature could be elected. With its legal status thus determined, it remained only for the officials to reach the Territory to give it life. Section 2 of this act described the separate executive, legislative, and judicial powers. Under this section, the judicial power was vested in a supreme court of three judges, to be appointed by the President of the United States, and such inferior courts as the legislative council should later prescribe by law. There was provision for a district attorney, to be appointed by the President, subject to approval by the Senate. The same powers previously extended to these appointed officials under the earlier experience of the New Mexico Territorial period was extended to the new officers in the Arizona Territory.

After President Lincoln made this act effective

with his signature, he began the selection of officials. His appointees assembled at Fort Leavenworth, proceeded via Santa Fe and, once within the eastern boundaries of Arizona at Navajo Springs, on December 29, 1863, formally established civil government in the newly-established Territory of Arizona.

John N. Goodwin of Maine was the first governor; Richard C. McCormick of New York, the first territorial secretary; William F. Turner of Iowa, the first chief justice of the Supreme Court; William T. Howell of Michigan, and Joseph P. Allyn of Connecticut, the first associate justices of the Supreme Court; and, Almon Gage of New York was the first district attorney. With a population of about 6500 in the Territory, government was set up initially at Fort Whipple, but in May, 1864, it was moved to nearby Prescott.

Acting within his powers, Governor Goodwin, on April 9, 1864, divided the Territory into three judicial districts: the First Judicial District comprising all land east of 114 degrees longitude and south of the Gila River, shortly thereafter by legislative action designated as Pima County; the Second, all west of 114 degrees, soon to be known as Yuma and Mohave counties; and the Third, all east of 114 degrees and north of the Gila, later to become Yavapai County. Judge Allyn was to be the presiding judge at Prescott.

The First Territorial Legislature altered this arrangement somewhat by changing the longitude figure of 114 degrees, in all three instances, to 113 degrees and 20 minutes west in describing county boundaries. This legislature also provided that the Supreme Court should convene once each year,

first at Tucson in 1865, then at Prescott, and finally, at La Paz. Later the Court was required by subsequent legislation to meet annually at the seat of government, its sessions to begin on the second Monday of January. Thus, the court moved to Prescott until 1867, then to Tucson from 1867 to 1877, back to Prescott until 1889, and, in 1889, was finally located at Phoenix.

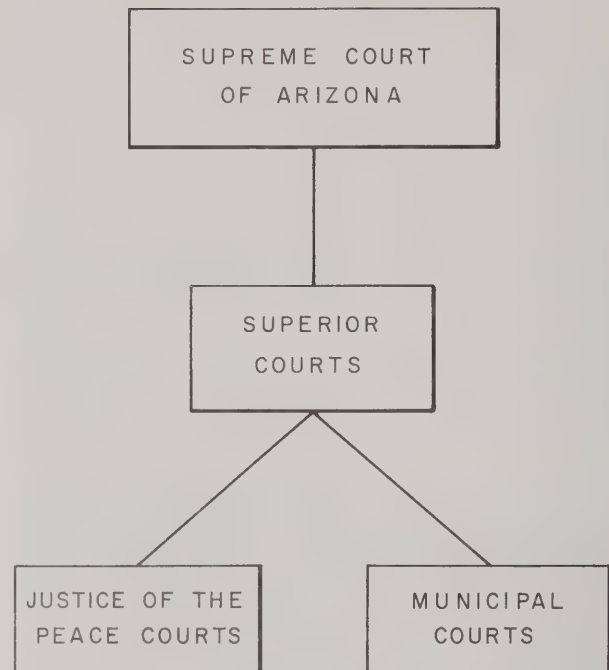
The first code of laws for the Territory of Arizona was the Howell Code. It was adopted on October 3, 1864, and remained the basic law until 1877. It was fashioned from a combination of New York and California statutes, and included the abandonment of many of the old common law modes of judicial procedure.

This Howell Code provided for the following territorial courts: (1) the Supreme Court, (2) the district court, (3) the probate court, (4) the justice courts, and (5) such other courts of a police character to be established later by law.

From Territorial days until statehood, the judges appointed by the President to serve in Arizona wore three hats. As trial judges sitting in a county seat, each had two functions. For the first six days of each term of court, the judge had the same jurisdiction in all cases arising under the Constitution and laws of the United States as was vested in circuit and district courts of the United States; and thereafter, until the next term, he had limited general jurisdiction over cases arising under the Territorial Code with such powers and duties as were therein prescribed. As a third function, each judge was a member of the Territorial Supreme Court, which met at the seat of government, where the presence of two judges, in the beginning, constituted a quorum.

Later, there were several changes in the law, particularly in the matter of whether a trial judge might also sit as a supreme court justice in a case he had decided below. So long as the Supreme Court had only three members, there was no federal or Territorial statutory language to prohibit him from so sitting, and the cases show that such judges who participated on appeals sometimes voted to reverse their decisions given in the lower courts. Then in 1885, the Thirteenth Legislature, by its Act No. 33, provided that a trial judge could not participate on the appeal from a case wherein he had presided. At first, this appears to have been unconstitutional because it imposed limitations upon the Organic Act passed by Congress. From an inspection of reported cases, however, it seems that the court paid little

THE COURTS OF ARIZONA



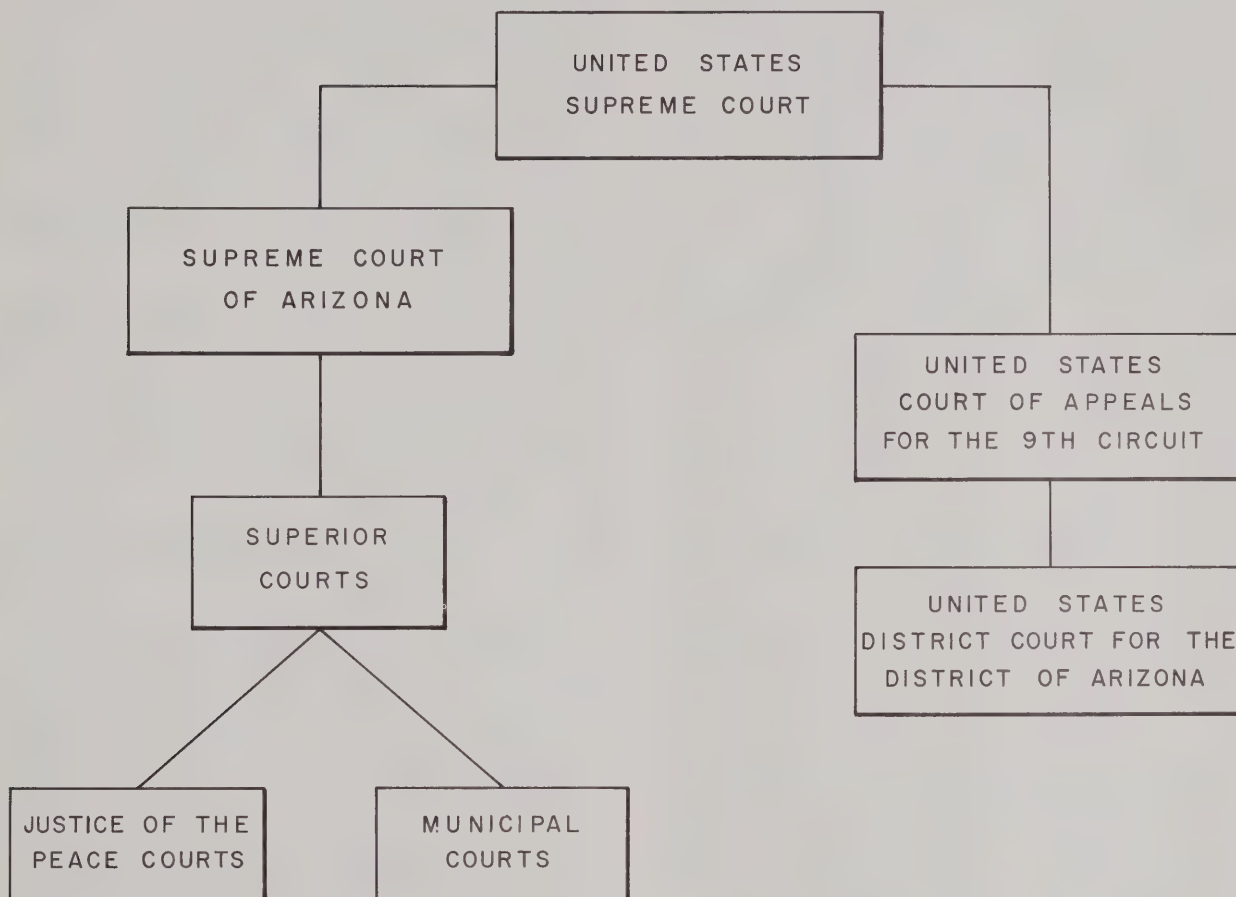
attention to this act, and it was repealed two years later by the Revised Statutes of 1887.

But then Congress adopted the idea. Possibly for cause or possibly to avoid two-to-two decisions, a change was made in 1891, by 26 United States Statutes at Large, chapter 131, page 747, where the number of Arizona Supreme Court justices was raised from three to four, while preventing such justices from serving in an appellate function in cases previously rendered by them in lower courts. Four years later, by chapter 1429 of the United States Statutes at Large for 1905, page 998, the Arizona Territorial Court was again increased from four to five, for which any three might constitute a quorum. Like the previous statute, judges were prevented from serving on the Supreme Court in cases in which they had an interest.

Each district judge received a federal salary of \$3,000 per annum, and the Territory furnished the premises, equipment, and services for holding court. In 1901, an additional sum of \$1,000 per annum to each was authorized by the legislature to be paid out of Territorial funds.

Judges were appointed for terms of four years, or until the President named a successor, but many served for lesser periods, particularly in the early days. For some, coming from more civilized sections

INTERRELATION OF THE ARIZONA COURTS AND
THE PRINCIPAL UNITED STATES COURTS



of the country, Arizona was an uninviting prospect.

A complete roster of Territorial judges and their terms served may be found in a 1941 publication by the Arizona Statewide Archival and Records Project, Historical Records Survey Program in the Work Projects Administration in Phoenix, entitled, *The District Courts of the Territory of Arizona, 1864-1912*.

When Congress increased the number of judges in the Territory, it also increased, in each case, the number of judicial districts. In 1901, the judicial districts were four; in 1905, they numbered five. In this last act, the power to further divide judicial districts was left to the members of the Territorial court. This liberty to change district boundaries was important because new counties were being created by the legislature, with new county seats where courts would be convening, and re-grouping of counties into judicial districts was economically advisable.

A new forum of short life, called "the county

court," was created for four counties, Mohave, Cochise, Apache, and Pima, in 1885, and was abandoned in 1887. It was designed to have original and appellate jurisdiction concurrent with the district court in all matters not arising under the Constitution and laws of the United States; and even there, the legislature intruded to give this county court power of naturalization and to issue papers therefor, a power not granted by Congress to purely territorial courts until 1906.

To broaden its base the county court was to succeed to the jurisdiction and functions of the probate court on January 1, 1887, thus to become, in fact, the precursor of the Superior Court introduced twenty-five years later with statehood. But since it was so largely a duplication of the established district court, which was left unchanged, it proved of small value even in isolated counties, and in Apache County was regarded as an expensive luxury.

Business was more brisk for this court in Tucson. Among the index volumes for civil actions in the office of the county clerk of Pima County, beginning in 1864, an interloper Volume No. 3½ is the index for actions filed in the Pima County Court, numbering 204, for the period from April 11, 1885, to a date in February, 1887. Judges for the county court were initially appointed in 1885 by the governor — to be succeeded January 1, 1887, by judges elected in November, 1886.

From the Howell Code until statehood, Arizona law provided for a probate court and judge in each county. This officer did not need to be a lawyer. The office was elective after 1875, and, by statute, came to have a number of *ex officio* duties, including membership on the board of county commissioners until supervisors replaced them, as well as the task of serving as the county school superintendent. The individual office-holder could serve as his own clerk of court, for extra salary. His court had jurisdiction over the proving of wills, the appointment of executors and administrators, and full supervision over the handling and settling of estates, including the partition, distribution or sale of real estate assets. Appeals from probate court went to the district court.

On the lower level of Territorial courts were the justices of the peace, who had their traditional field for small civil claims and for adjudging on minor breaches of the law and providing preliminary hearings on more serious charges; and other courts of a police character, such as police or mayor's or municipal courts, to handle breaches of city or town ordinances. The recorder's court, mentioned in statutes and codes from 1864 to 1928, did not refer to a county official but to a city or town recorder, who, under specific ordinance, might have power to sit on cases for the recovery of penalties and forfeitures incurred under municipal regulations.

An Arizona judge at the turn of the century not only heard a diversity of matters, he lived a crowded schedule in disposing of his several dockets.

Statehood for Arizona was achieved under circumstances affecting the judiciary. The proposed constitution adopted at the election of February 9, 1911, included a section establishing the voters' right to recall all persons holding elective office, whether elected or appointed. This, of course, included all judges and other judicial officers. This was a victory for the labor wing of the Democratic party as well as part of the historical backwash of the Progressive movement on the national scene.

Congress, by joint resolution for statehood, adopted this constitution as submitted, but President Taft vetoed it. Congress then inserted words excepting the judiciary, repassed its joint resolution, and the bill was approved by the President on February, 14, 1912. By an amendment submitted to the Arizona voters on November 5, 1912, the original section without the exception regarding the recall of judges was restored, and it is now Section 1 of Article VIII of the State Constitution. The right of recall against a judge has been invoked in Arizona only once.

The new status, of course, brought an end to the three-hat era for Arizona judges. The United States district court became a separate institution for cases arising solely under federal law or transferable to a federal forum, with northern and southern divisions centering at Phoenix and Tucson, and its two judges were appointed by the President for life. There are quarters available in federal buildings at Prescott and Globe for sittings of federal court at the judge's direction, but no court personnel or records are maintained there. All court files of civil and criminal cases and of bankruptcy matters docketed on the federal side of all Arizona Territorial courts, as well as Territorial naturalization records, are now stored at Phoenix in the custody of the clerk of the United States district court. Since statehood, the files of disposed-of cases have been periodically boxed and sent to the Federal Records Center in Wilmington, California. Federal court appeals no longer go directly to the United States Supreme Court, but are normally routed to the U.S. Court of Appeals for the Ninth Circuit at San Francisco.

For a state judicial system, Article VI of the state constitution provides in outline for the same court levels as during Territorial days, except that the probate court is eliminated. There are the Supreme Court, the Superior Court, justices of the peace, and lesser police magistrates. The functions of the probate court have passed to the Superior Court.

Article VI, Section 4, of the state constitution, provides that the Supreme Court has original jurisdiction in habeas corpus, *quo warranto*, and *mandamus* as to state officials, and both original and exclusive jurisdiction as to actions between counties. It has appellate jurisdiction in all actions and proceedings, except in civil law actions where the controversial value does not exceed two hundred dollars unless the validity of a tax impost, assessment, or statute is involved. This broad language, therefore,

empowers it for direct and final hearing on writs of *certiorari* from awards or decisions by state boards and commissions unless by statute the litigants are sent elsewhere. This includes claims adjudicated by the Industrial Commission under the Workmen's Compensation Law, 1956 Arizona Revised Statutes, 23-951. The court is obliged to set such matters for hearing within ten days unless continued for cause. In January, 1960, the Supreme Court was about twenty-one months behind on its docket. It has been falling three to four months further behind each year. Hence the requirement for putting compensation cases regularly at the head of the calendar is a continuing deterrent to other appealed litigation. With increasing industrialization a considerable factor in the state's economy, this preference given *certiorari* matters could become a cogent argument for the creation of an intermediate appellate court to take over the review of administrative awards and decisions by all commissions and boards.

The constitution also requires that all Supreme Court justices participate in each case unless disqualified, and in the latter case a Superior Court judge is called to fill in. A further reform proposal would increase the Supreme Court to seven regular members and permit it to work in panels of three unless cause for an *en banc* sitting is shown. Just to increase the size of the court would not suffice; there must also be the certainty of increasing its output.

The constitution provides that the Supreme Court membership of three may be raised to a higher number by the legislature, and it was so raised to five in 1947. Justices are elected for a six-year term, with the chief justiceship rotating annually by seniority of service; and the salary, beginning with \$5,000 in 1912, has now been raised to \$15,000 annually for each justice. Superior court judges originally were paid from \$3,000-4,000 annually, depending upon county property valuation; but now, in view of their statewide assignments, they receive \$12,500 annually. There also is a state retirement system for both levels of the judiciary with twelve or more years of service.

Under Article VI, Section 6, of the constitution, the Superior Court is the only court of record at the *nisi prius* level in Arizona, and, along with appellate jurisdiction from cases arising in justices of the peace and other inferior courts, it has original jurisdiction in all law, equity or statutory actions unless right of trial or hearing is by statute vested elsewhere.

Until 1948 the constitution provided for one

Superior Court for each county, but an amendment, Article VI, Section 25, in that year declared that the Superior Courts provided for in the article constitute a single court of the state, embracing the judges of all counties. This provision facilitates the concentration of judges at the busiest points when home schedules permit absence. Section 5 of said Article VI provides that for each county having a census enumeration greater than thirty thousand inhabitants, one judge of the Superior Court for each additional thirty thousand, or major fraction thereof, may be provided by law.

Since final organization of Arizona into fourteen counties there has been only one change of county seat: in Cochise County, from Tombstone to Bisbee in 1929. In only two counties, Pima and Maricopa, does Superior Court have more than one place of sitting. A judge from Tucson travels 125 miles to Ajo when trial matters are scheduled there. A regular court room, deputy clerk, and deputy sheriff are maintained there. A Superior Court judge from Phoenix sits regularly on Friday afternoons in an alternate location at Mesa for civil, non-jury matters, and with power also to hear criminal arraignments; however, no permanent court personnel are maintained at Mesa. For many years Maricopa and Pima counties were the only counties where the Superior Court operated in multiple divisions, there being now eleven divisions in Maricopa and five in Pima. However, with new census figures available in 1960, Yuma and Pinal counties have each authorized a second division, and the one in Yuma began functioning in July with the appointment of a judge by Governor Fannin. In Pinal County the supervisors created the second division but it was not to become operative until the election of a judge in November, 1960. In the early 1920's two judges manned two divisions of the Cochise County court at Tombstone, but a declining population cut it back to one in 1925. Of these, Judge Alfred C. Lockwood advanced to the Supreme Court in 1925, and Judge A. M. Sames became the federal district court judge at Tucson in 1931.

The Superior Court dockets in all the smaller counties are relatively current, a trial setting usually being possible within four to eight weeks. In Pima, the device of an assignment judge voluntarily supported by the five judges, maintains the trial calendar at a delay of only four or five months. In Maricopa County, where there may be a need for another division of the court, and where, also, the judges

are said not to have so well developed the device of using an assignment judge, the trial calendar is now about two years behind.

The Supreme Court has on several occasions stated that it has inherent power to make rules governing procedure matters in both trial and appellate courts, and it has often used that authority to liberalize rules as they become outmoded. Statutory authority to complement inherent power was granted by the legislature in 1939. Shortly afterwards a comprehensive revision in civil rules was announced by the Supreme Court, to begin January 1, 1940, when the new system of procedural rules then going into effect in United States district courts were also to become (with very few exceptions) the rules for Arizona courts. Arizona was the first state in the Union to substantially unify state and federal pro-

cedural rules, and this has been a helpful thing for lawyers and their clients. After the experience of a decade there was a series of amendments to the federal rules, and in due time the Arizona rules have been largely modified again to conform.

A program for considerable changes in court administration, establishment of an intermediate appellate court level, increase in judicial salaries, and other matters was presented in a bill before the 1960 Arizona legislature, but it did not reach the action stage before adjournment. Subsequently, the State Bar of Arizona, at its annual convention, voted to undertake a campaign to qualify the bill as an initiative measure, for submission to the voters at the November, 1960, general election.

Thus, the judiciary continues to change — as it has always in the legal history of the state.



..... *public finance*

IN FISCAL YEAR 1912-13, THE FIRST FULL YEAR of statehood, public spending by the state of Arizona totaled a bit over \$1,600,000 exclusive of refunding about one and one-half millions of Territorial bonds. The cost of general government accounted for more than 30 percent of the total, and interest on the public debt took another 10 percent. But in fiscal year 1957-58 these two items together accounted for only 3 percent of the total general expenditures of nearly 189 million dollars. The cost of general government has dwindled in comparison as the state has engaged in the modern functional operations of education, highways, welfare, and hospitals. These functions currently absorb about 70 percent of the total general expenditures of Arizona, whereas in 1913 they accounted for only 40 percent of a small total. For highways and welfare a substantial portion of the cost is now met by grants-in-aid from the federal government.

Growth in the state expenditures for education, highways, welfare, and hospitals is simply a reflection of the national trend. The higher the level of our national income, the greater the amount of services that we demand from our government.

The authors of the constitution of Arizona profited from the experience of the older states in safeguarding the financial interests of the people of Arizona. Some of the older states have had financial difficulties when they borrowed money to finance banks, canals, railroads, and other enterprises. Such problems are, in fact, as old as the Union itself. The principal revenue provision of the Arizona constitution states that "the power of taxation shall never be surrendered, suspended or contracted

away." Other revenue provisions prevent the use of state taxes to support any church, private or sectarian school, or public service corporation; deny the granting of subsidies and the lending of state credit to private business; and place a limit of \$350,000 on the state debt. The limit does not apply to funds borrowed to repel invasion, suppress insurrection, or to defend the state in case of war. Arizona has experienced neither invasion nor rebellion, and thus far the federal government has incurred the debt to defend the state during wartime.

According to the state auditor, Arizona's fiscal condition was strong in 1960. At the end of fiscal year 1959-60, the only state debt was \$5,000 of bonds which were still outstanding. However, these bonds were due June 1, 1955, and the money has been set aside for their payment.

The constitution of Arizona contains two clauses which provide that tax laws must state the specific object of each tax and that payment of taxes must be in money only. These provisions are clearly aimed at straightforwardness in state public finance. They have given rise to compartmentalization of Arizona finances into separate funds, including the general fund, and special funds, such as the highway fund. Were it not for the provision of a general fund, strict adherence to the constitutional requirement that the object of each tax be stated would lead to great complexity of institutional accounting.

Arizona is a sovereign state in contrast to the federal government which has delegated powers. The federal Constitution gives the federal government the power "to lay and collect taxes, duties, imports and excises . . ." Since Arizona is a sovereign unit

of government, its constitution need not have a similar provision with respect to the power to tax because such power is inherent in sovereign governments. Nevertheless, again profiting by experience of other states, Arizona's constitution specifically gives to the law-making body the power to levy and collect all manner of specific taxes. The manner, method and mode of assessing, equalizing, and levying same is to be prescribed by law.

In 1912, at the beginning of statehood, the principal tax used by Arizona was the general property or *ad valorem* tax. Instead of the general property tax, a gross earnings tax was imposed on railroad companies which possessed considerable rolling stock without a definite tax status. An inheritance tax was also enacted at this time but for many years it yielded little revenue.

The general procedure provided for determining the property tax is still in use today. The property tax rate is determined by dividing the budgeted expenditures by the total assessed value of all property. Each property owner's tax bill is determined by multiplying this rate by the assessed value of his property. County treasurers collect this tax along with property taxes imposed by the counties, incorporated cities, and school districts. The state's share is then turned over to the state treasurer.

At the time of World War I and the years immediately thereafter, the growing use of automobiles and the demand for surfaced highways led most states to pass laws providing for a tax on motor fuel. Arizona followed suit and the gasoline tax became Arizona's second major tax. The proceeds from this tax, as well as the revenue from highway vehicular license fees, have from that time been administered as a special fund by the State Highway Commission instead of the Tax Commission.

As in other states, the years of extremely depressed economic conditions in the early thirties affected the state revenue by reducing tax income. For a while the state paid its current bills in interest-bearing warrants that were not immediately redeemable. To improve this situation, three new taxes were added to Arizona's tax structure: a privilege sales tax, an income tax on individuals and corporations, and a luxury tax on the sale of tobacco products and alcoholic beverages. In order to help the counties, a portion of the yield of the sales tax was shared with the counties. A *pari-mutuel* tax was also enacted and, later, under the national Social Security Act, a payroll tax to finance Arizona's unemployment

insurance program was provided. Later, the inheritance tax was converted into an estate tax designed to take advantage of the maximum credit granted under the estate tax of the federal government.

At the present time Arizona derives its tax revenue primarily from six sources; a general property (*ad valorem*) tax, a tax on gasoline, a sales tax, an income tax on individuals and corporations, revenue from fees, permits and licenses, and the luxury tax. In fiscal 1958-59 these sources yielded \$117,112,973 in revenue to the state.

The revenue from the payroll tax for unemployment insurance goes into a trust fund held for the state by the federal government. Unemployment benefits are paid from this fund to eligible claimants. In fiscal 1958-59 such claims totaled \$8,285,970, an increase of 11 percent over the previous fiscal year. In the same period, payroll taxes for unemployment insurance amounted to \$8,483,728. The excess of payroll taxes over claims, plus the interest on the bonds held in the fund, caused Arizona's Unemployment Insurance Trust Fund to gain more than \$1,700,000 in the fiscal year and to reach a total of \$59,000,000. In this regard Arizona is financially in a superior position to many other states of the Union.

When the sales tax was first enacted in Arizona, the law provided that a portion of its yield, about 40 percent, be divided among the fourteen counties in order to lessen the burden of the county *ad valorem* taxes on property. Later, this law was amended so that a portion of the sales tax is also divided among the incorporated cities on a population basis. This is one factor which has encouraged the annexing of surrounding areas by cities in recent years. A portion of the revenue from the gasoline tax is also divided among the counties and cities. The sharing of this tax was also motivated by a desire to lighten the load of the property taxes levied by cities and counties. The money from this gasoline tax is earmarked solely for highway usage, and cannot be spent by any unit of government in Arizona for any purposes other than the construction and maintenance of highways.

Beginning more than twenty years ago the state of Arizona and, later, its counties have followed the practice of making grants-in-aid to the school districts. These grants have been flat amounts per pupil on an average daily attendance (ADA) basis. Although these grants have increased from time to time, rapidly growing school enrollments, especially in the urban areas, have placed greater tax burdens

on property in school districts where the number of children is large in relation to the valuation of taxable property. To relieve this situation, in 1959 the state sales tax rates were increased from 2 to 3 per-

cent on retail sales. The money from the additional 1 percent tax was set aside to increase the state aid to school districts and thus lessen the inequities which currently exist in school district property tax rates.



..... *local government*

DESPITE INCREASING POPULATION CONCENTRATIONS and governmental centralization, the governing of American society continues, to the greatest extent, in decentralized form at the local level. In 1957 the U. S. Bureau of Census reported the existence of 102,279 local governmental units in the United States.

Ranking forty-first among the states in numbers of local government units, Arizona contained 366 such units in 1957. This total included fourteen counties, fifty-two municipalities, 250 school districts, and fifty special districts. Developments in the state since 1957 indicate that the total number of government units in Arizona will show an increase by the next census of governments, primarily because of new municipal incorporations and new school districts created.

Arizona's local government units, like similar units in other states, perform varied functions — ranging from single-purpose special districts concerned with providing hospital services for a specified area to multiple-purpose municipal incorporations concerned with providing the public needs of a concentrated urban area.

Although public agencies are organized at the local level to service local needs, local government units are legal creations of the state and thus are subordinate to and controllable by the state, and are created for the sole purpose of exercising the limited part of the sovereignty delegated to them. As the law-making body which represents the people of the state, the Arizona State Legislature serves as the most important of constitutional agencies which regulate the substantive and procedural activities of

local government units. Thus indebtedness, expenditure, and taxing limitations; revenue powers; governmental forms; election procedures; and functional power are all restricted by constitutional and legislative stipulations.

Yet it is also true that local government units are protected to some degree from legislative interference. For example, the Constitution of Arizona, as a measure of insuring some degree of local autonomy, prohibits the state legislature from passing "special legislation," i.e., a law which affects only one or two selected local units on certain subjects.

County Government

Arizona's 113,909 square miles and estimated 1,288,000 population are organized into fourteen counties. Four of these counties — Mohave, Pima, Yavapai, and Yuma — were in existence when Arizona was separated from New Mexico in 1863 and given independent Territorial status. Subsequent to this date, these four counties were broken up to form ten additional counties: Pinal, 1875; Apache, 1879; Cochise, 1881; Gila, 1881; Graham, 1881; Coconino, 1891; Maricopa, 1891; Navajo, 1895; Santa Cruz, 1899; and Greenlee, 1909–1911. Coconino, containing 18,573 square miles, is the largest county (and the second largest in the continental United States), and Santa Cruz, with 1,246 square miles, is the smallest in land area. Maricopa, with an estimated 1960 population of 657,000, is the most populous county, with Pima (261,000) second, and Mohave (7,700) the smallest.

County governments function primarily in the rural and non-incorporated urban areas of Arizona.

The functions performed include public works, highways, institutions and buildings, public safety, assessment and tax collection, charities, and corrections, and elections.

The governmental and administrative organization through which these functions are performed is somewhat decentralized, and includes the following elective officials: a three-member board of supervisors, sheriff, superintendent of schools, attorney, assessor, treasurer (ex-officio tax collector), and recorder. Each elective official serves for a two-year term of office. Each member of the board of supervisors is elected from one of three supervisory districts, but the remaining officials are elected at-large. The general qualifications for county elective positions require the candidate to be at least twenty-one years of age, a citizen of the state and an elector in the county or precinct in which he works, and able to read, write, and speak the English language. No limitation is placed upon number of terms served.

The more highly urbanized counties in Arizona have added to the above administrative machinery by establishing such appointive positions as finance director or budget officer, planning director, and personnel director. In 1952, Maricopa County partially integrated its administration by establishing the post of county manager and vesting in this officer the responsibility for administration, direction, and coordination. In part this organization was instrumental in gaining an All America County Award for Maricopa in 1956.

Municipal Government

Although a population of 500 is necessary for incorporation, Arizona's municipalities range in size from 400 (Jerome) to 434,277 (Phoenix) inhabitants. The smallest town in land area contains ninety-one acres (Winkelman) and the largest city 187.4 square miles (Phoenix). The oldest municipality is Tucson (1877) and the youngest Kearny (1959).

Since 1957 Arizona has gained five additional incorporations, bringing the total number of municipalities to fifty-seven. These contain an estimated 75 percent of the state's population, and the two standard metropolitan statistical areas of Phoenix and Tucson (see below) contain 72 percent of the state's population and sixteen of its municipalities. As indicated by these data, Arizona's municipal growth has not been confined to an increase in numbers of incorporations. Population and area growth have been outstanding contributions to total growth,

especially during the decade 1950–1960. Leaders in this growth were the state's two largest cities, Phoenix and Tucson. In 1950, Phoenix covered 17.1 square miles and had a population of 106,818. At this same date Tucson covered 9.55 square miles and had a population of 45,454. By 1960, through vast annexation programs, natural growth, and the influx of people from other states, the land area of Phoenix had increased to 187.4 square miles, and its population had risen to an estimated 434,277. Through similar growth patterns, by 1960 Tucson had an area of 70.9 square miles and a population of 210,016. Other municipalities — notably Bisbee, Flagstaff, Mesa, Scottsdale, Tempe, and Yuma — enjoyed significant growth in land area and population.

For legislative purposes, municipalities are classified as cities or towns. Classification is based upon population, but a change of classification is not mandatory. Municipalities with less than 3,000 population are designated as "towns." But those municipalities with more than 3,000 population *may*, with voter approval, change their status to that of a "city." Although a change from town status to city status involves no gain or loss of substantive powers, cities do have three options not permitted towns: (1) the option of adopting a ward system of council selection, (2) the option of adopting a system of overlapping four-year terms for councilmen, and (3) the option of paying salaries to mayor, councilmen, and board members. Thirty-two municipalities are classified as towns and twenty-five as cities.

The basic form of government used in Arizona's cities and towns is a simple one. In towns of less than 1,500 population, five councilmen are authorized, and in large towns and all non-charter cities, seven councilmen are required. Except in those cities using a ward system, all councilmen are elected at-large and a mayor is selected by the council from among its membership. Cities using the ward system elect a mayor-at-large. In all cases the mayor is the "executive officer" of the municipality. All terms of office are for two years, except for councilmen in cities using the system of overlapping four-year terms. Common Council Government is the phrase which describes this form of organization, and forty-six cities and towns are organized on this basis.

Ten Arizona cities have taken advantage of a general constitutional grant of charter, or "home rule," government. Tombstone retains its Territorial special charter. However, since charter provisions

and subsequent city ordinances must be consistent with the constitution, and give way to state legislation where there is a conflict, the quantitative number of advantages of charter government are small. Essentially, these advantages, provided they have been granted by the city's charter, are:

1. The authority of cities to select any form of governmental organization they may prefer. This, of course, permits the tailoring of the municipal organization to fit the desires and needs of individual cities.
2. The authority to compensate the mayor and councilmen, and other municipal officials and employees, as much as the city deems necessary.
3. The authority to control the method and manner of conducting municipal elections.
4. The authority to maintain its own assessor and to make its own assessment rolls on its own valuations.
5. The authority to raise and use funds for advertising purposes without the usual legislative limitations.

Although cities must have a population of 3,500 before qualifying for home rule status, acquisition of charter government status in Arizona is virtually self-executing. The constitutional procedure requires only the approval of a proposed charter by the voters of the city and the state's governor.

Twenty-two Arizona municipalities have adopted the council-manager form of government — eight by charter and fourteen by ordinance. Adoption by charter action has resulted in the strongest council-manager practices, since this method requires the consent of the voters for adoption and any amendments to the plan. Further, charter adoption of manager government has permitted strengthened administrative practices through defining council-manager relations in the charter. Due in part to the effectiveness of its council-manager government, Phoenix won All America City awards, sponsored by the National Municipal League and *Look* magazine, for 1950 and 1958.

The fourteen Arizona cities and towns using the ordinance method for adopting council-manager government continue to operate under the common council system of government. Under this system the council has the option of adopting or changing any feature of the manager plan, the voters playing only an indirect role.

Essential features of council-manager government include a non-partisan elected mayor and council (except in Tucson where both are elected

on a partisan basis and councilmen are nominated by wards and elected at-large), a manager appointed by and responsible to the council, and manager control over administrative machinery.

Arizona's municipalities are organized, for coordinative, educational, and representative purposes, into a League of Arizona Cities and Towns boasting 100 percent membership. Auxiliary organizations of professional municipal administrators include the Arizona City Managers' Association, City Attorneys Association, City Clerks Association, Planning and Zoning Association, Police Chiefs Association, Fire Chiefs Association, and Arizona Chapter of the American Public Works Association.

The *Directory of Arizona Cities and Towns*, published by the League of Arizona Cities and Towns in July, 1959, lists municipalities according to governmental forms as follows:

Common Council Government

MAYOR-COUNCIL TOWNS (26). Benson, Buckeye, Clarkdale, Clifton, Duncan, Eagar, El Mirage, Florence, Fredonia, Goodyear, Holbrook, Huachuca City, Jerome, Kearny, Mammoth, Parker, Patagonia, Pima, Sierra Vista, Snowflake, Somerton, South Tucson, Springerville, Thatcher, Williams, Winkelman.

MAYOR-COUNCIL CITIES (6). Bisbee, Douglas, Kingman, Safford, St. Johns, Show Low.

COUNCIL-MANAGER TOWNS (6). Eloy, Gilbert, Hayden, Miami, Peoria, Wickenburg.

COUNCIL-MANAGER CITIES (8). Casa Grande, Chandler, Coolidge, Globe, Mesa, Tempe, Tolleson, Willcox.

Charter Government

MAYOR-COUNCIL CITIES (3). Nogales, Tombstone, Yuma.

COUNCIL-MANAGER CITIES (8). Avondale, Flagstaff, Glendale, Phoenix, Prescott, Scottsdale, Tucson, Winslow.

School Districts

In 1960 Arizona contained seventy-one high-school and 227 elementary public-school districts, for a total of 298. The 1960 total showed an increase of forty-eight over the 1957 school district count by the U. S. Bureau of Census of 250. However, while all school districts are discrete entities for financial purposes, some are administratively grouped with others and governed by a single board of education.

In addition to these established school districts there are six accommodation schools operating in the rural areas of five counties. Accommodation schools are county agencies and are considered as part of the regular county administrative organization.

Special Districts

In 1957, the U. S. Bureau of Census reported Arizona as having fifty special district governments. Composing this total were six electrical districts, two hospital districts, twenty-three irrigation districts, seventeen irrigation water delivery districts, one sanitary district, and the Salt River Project Agricultural Improvement and Power District. Since 1957, additional special districts have been created in several counties. In 1959 the state legislature authorized the creation of county flood-control districts.

In addition to special district governments, independent of county and municipal governments, there are various types of county and municipal agencies existing to serve specified areas or purposes, i.e., zoning districts and improvement districts. These agencies, however, are distinguished from special districts in that the latter are controlled by locally elected boards and are authorized to incur debt and levy taxes, and, where appropriate, to finance by special benefit assessments or service charge.

Standard Metropolitan Statistical Areas

As defined by the U. S. Bureau of Census, Arizona contains two of the nation's 192 standard metropolitan statistical areas. The largest of these, the Phoenix SMSA, consists of all of Maricopa County, and includes fourteen municipalities, sixty-three school districts and a few special districts (notably the Salt River Project Agricultural Improvement and Power District). The Phoenix SMSA population totals an estimated 657,000, with the Urban Area occupied by an estimated 525,000. No over-all metropolitan government exists, but the City of Phoenix contains 187.4 square miles of the Urban Area's approximately 230 square miles. Annexation, intergovernmental compacts, and other cooperative devices have served partially to integrate governments in the Urban Area.

The Tucson SMSA consists of all of Pima County, and includes twenty-five school districts, and five special districts. Core of the SMSA is the Tucson Urban Area served by the county, two municipalities, eleven school districts, and a few special districts. The SMSA population totals an estimated 262,000, with the Urban Area occupied by an estimated 250,000. No over-all metropolitan government exists, but the City of Tucson contains 70.9 square miles of the 336 square-mile Urban Area.



. *health and social services*

BLUE SKIES, CLEAR DRY AIR, AND MILD TEMPERATURES have made Arizona a leading health center for the people of the United States, and other countries as well. With adequate shelter, clothing, and conditioning of his environment, modern man has buffered himself against many of the more primeval effects of nature, but his response to the Arizona environment indicates that weather is still a dynamic force in daily life.

With the recognition of this force has come the development of the state's own health services, basically equivalent to those in other places, but frequently intensified to solve the special problems of health-seekers from all over the world.

The state's social and correctional services form a far-ranging program also influenced in many respects by factors especially characteristic of the area. These include the presence of migrant labor, large numbers of transient health-seekers, and ethnic groups whose per capita income falls considerably below the prevailing average for the state. The major areas of social and correctional service are concerned with adjustments in such groups, along with efforts to strengthen family life in the community, to protect its citizens and to rehabilitate individuals in need.

Health Services

DEPARTMENT OF HEALTH. The nucleus of this department was the Arizona Board of Health, created by the Twenty-Second Territorial Assembly in 1903, with Dr. R. M. Dodsworth as the first superintendent. The present department was created by legislation in 1941, and is supervised by a director, appointed by a state commissioner of health.

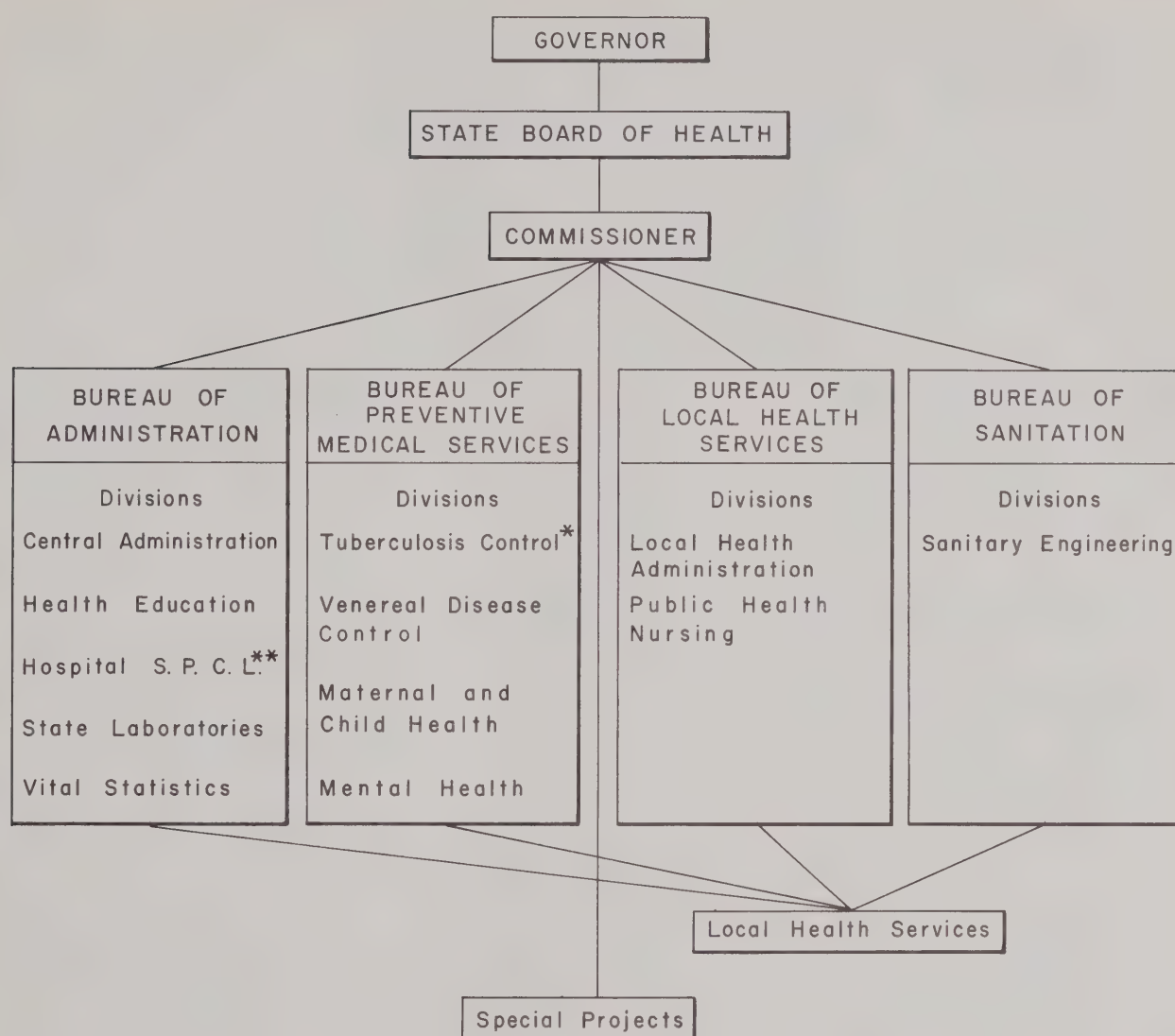
Directly or indirectly, with financial assistance and consultative services to local departments, the Department of Health serves Arizona through twelve operating divisions. These include the Bureau of Administration, with divisions of Health Education, Hospital Survey, Planning, Construction, Licensing, Vital Statistics, and State Laboratories, as shown in the chart on the next page.

Published under the auspices of this Bureau are the *Arizona Public Health News* and the *Statistical Supplement* to the *Annual Report*, the *Monthly Vital Statistics Report*, and the *Weekly Morbidity Report*.

The Bureau of Preventive Medical Services includes the divisions of Maternal and Child Health, Venereal Disease Control, Mental Health, and Tuberculosis Control. Dealing with one of the highest death rates from tuberculosis in the nation, Arizona's Division of Tuberculosis Control is dedicated to eradicating this major threat to the state's health. Outstanding among the services provided by this division, in conjunction with voluntary agencies, are the tuberculin test for school children, and the free mobile X-ray unit. Welfare assistance is available to indigent tuberculosis patients, and numerous other special services are provided, such as foster homes to protect children of tuberculars from infection, and transportation for needy non-resident patients to their home states after treatment here.

The Bureau of Sanitation is concerned with environmental factors bearing on the well-being of Arizona People.

The Health Department provides also a state nutritionist who functions as a health educator and participates in well-baby and pre-natal clinics with



*State Tuberculosis Sanatorium is included

**Survey, Planning, Construction, and Licensing

Organization chart of the Arizona State Department of Health

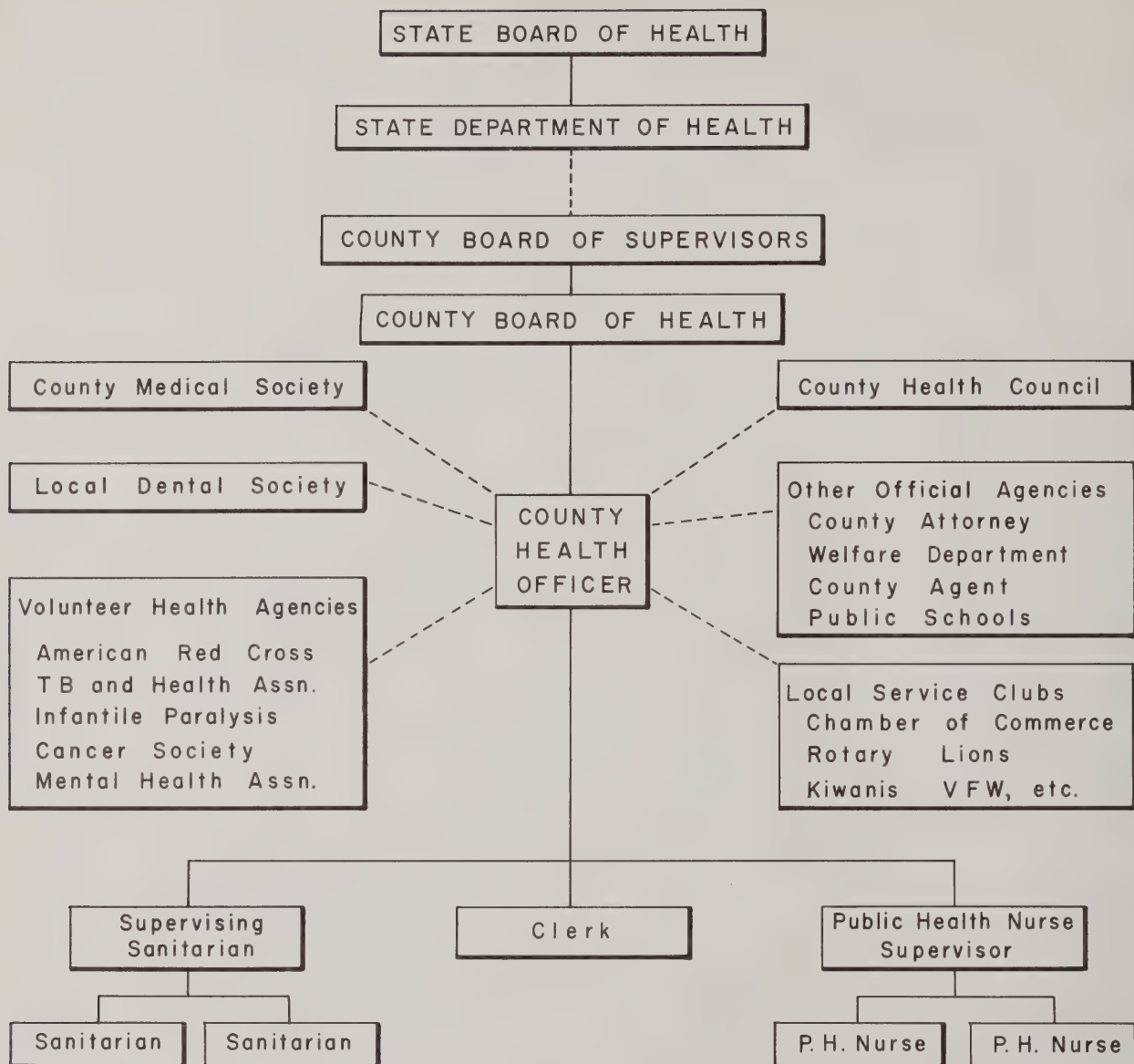
the Division of Maternal and Child Health. Also in operation is a multiphasic screening program for the detection of chronic and infectious disease, and — recently established — a program of blood-sugar testing for diabetes and eye-pressure testing for glaucoma. Providing additional services are a state dentist, frequently examining the public at fairs and other public gatherings, and a state veterinarian, chiefly concerned with diseases such as rabies, which are transmittable from animal to man.

Like all other health departments, Arizona's has administrative and public health problems, relating

in many instances to lack of funds to keep up with a rapidly growing population. Problems of air pollution and waste disposal are consequent upon the growth of the state and can be expected to increase with the influx of health-seekers, retired people, and more recently, of industry, into the state.

Of special significance in Arizona are the problems of tuberculosis discussed above, and of the migrant worker population, putting a burden on sanitation, venereal disease control, and health education.

In common with other state health services, Ari-



Organization chart of a typical local health department

zona's is a complex structure of coordinated efforts, centered around the practicing physician, supported by nurses, pharmacists, technologists — the efforts of all conveyed to the community through the public and private clinics, laboratories, and hospitals of the state.

HOSPITALS. Early Arizona needed hospitals for the same reasons as other areas — westward migration was increasing the population, and frontier life was marked by violence, by the everpresent possibility of accidents, and by communicable disease.

Arizona needed hospitals more than many other

areas, however, because of the influx of people with tuberculosis, who, even in those days, had begun to seek recovery in a mild, dry climate.

Many factors have contributed to filling the need. Church and mission groups pioneered the field for hospitals in Arizona. St. Mary's in Tucson was the first. Many other church-sponsored institutions followed. Even as late as 1930, Sage Memorial Hospital was founded by a Presbyterian mission on the Navajo Indian Reservation at Ganado in the northernmost part of Arizona. The tradition of founding and maintaining hospitals by religious groups con-

tinues today. A number of such hospitals date back to pioneer days.

Military life was another factor. Wherever army personnel were concentrated on the frontier, hospital facilities had to follow for care of the sick. Modern Arizona has a number of these installations still thriving, filling the need for a special segment of the population.

In many different ways the government of the United States has helped to supply needed hospitals for Arizona residents. There are the large Veterans' Administration Hospitals at Phoenix and Tucson, which have been especially strong in the treatment of tuberculosis. The Public Health Service takes care of members of various Indian tribes on reservations across the state.

In urban centers — primarily Phoenix and Tucson — community support and fund drives and contributions by private citizens have frequently energized and expanded hospital building. Cases in point are Tucson's Joint Hospital Drive in 1957 with \$1,600,000 divided between Tucson Medical Center and St. Mary's for expansion, and the original gift of the Desert Sanatorium by Mrs. A. W. Erickson to Tucson for a community hospital — the Tucson Medical Center of today.

Probably more than any other factor, however, federal grants have made it possible for the urban hospitals of the state to keep pace with the rapidly increasing population. In 1948, the Eighteenth State Legislature passed an act which made possible the participation of the state in the benefits of Public Law 725. Known as the Hill-Burton Act, this law provides federal assistance to states for hospital construction. Under the provisions of this act, a federal grant to a hospital can equal up to 50 percent of the total cost of construction and equipment, with the remainder of the cost being contributed by the sponsors in the community. The Arizona State Department of Health through its Division of Hospital Survey, Planning, and Construction, became the state agency to administer the Hill-Burton Act. The Division is responsible for conducting an annual survey of hospitals in Arizona to determine needs, for preparing an annual revision of the state plan for hospitals, for investigating requests for federal funds for construction, and for supervising construction projects. The first hospital plan for construction in Arizona was approved in May, 1948.

In 1954, the Wolverton Amendment to the Hill-Burton Act extended federal aid to states for sur-

veying needs and developing plans with respect to four new classes of projects: hospitals for chronically ill and impaired; nursing homes, public health centers, diagnostic and treatment centers, and rehabilitation facilities. The construction of a fifty-three bed nursing home addition to the Pinal General Hospital in Florence was the first project to be approved by the U.S. Public Health Service under this category.

During the twelve years that the Hill-Burton program has been in operation in Arizona, the following hospital and medical facilities have been provided for the state: 1532 general hospital beds, 120 beds for tuberculosis, 48 chronic-disease beds, 208 nursing home beds, 9 diagnostic and treatment facilities and 2 rehabilitation facilities. Total cost of these beds and facilities has been \$26,617,764. Hill-Burton and Wolverton grants have totalled \$10,441,451, and sponsors in the communities have furnished the balance of the cost. Substandard beds have been replaced in many areas; inadequate facilities have been improved, as well as new ones provided where none existed before. However, due to the surge in population, there still exists a shortage of hospital and medical facilities. To illustrate this point, Arizona, in 1948, had 44 general hospitals with 2557 suitable beds. This represented 71.7 percent of the total number of beds needed for the 649,000 people then residing in the state. In 1959, Arizona had 60 general hospitals with 3795 beds; however, in spite of this increase, there are only 67.8 percent of the number of general hospital beds needed for the 1,288,000 people in Arizona today. In short, there has been an increase of 48.4 percent in the number of general hospital beds; however, the population on which bed-need is based has increased 72.2 percent.

There is at present a shortage of suitable hospital beds and facilities in Arizona. The deficiency is not only in general facilities, but with respect also to special accommodations for tubercular and mental patients. The Arizona State Plan for construction of hospitals, public health centers, diagnostic and treatment centers, nursing homes, and rehabilitation centers, which bases the bed-need for tuberculosis patients on the number of active communicable cases that need hospitalization, reports that 392 beds are needed in addition to the presently available suitable beds for tuberculosis patients. One hundred of these additional beds are proposed for the Arizona Tuberculosis Sanatorium in Tempe, and the remainder for various general hospitals throughout the state. The

1538 suitable mental hospital beds in Arizona represent only 27.5 percent of the total bed-need as determined by the state ratio of 5 beds per 1000 population. At present, only 2 county hospitals and 1 private facility, with a combined total of 88 mental hospital beds, supplement the Arizona State Hospital. Although this latter hospital is providing well-rounded care for the various types of mental illness, it is in need of expansion, and the Arizona State Plan has proposed for it another 1,100 beds. Additional beds are proposed for general hospitals in Phoenix and Tucson, and some are left unassigned for use by other hospitals where there is need for mental facilities.

MEDICAL PRACTICE. The practice of medicine in early Arizona forms a fascinating chapter waiting to be written — a chapter as vigorous and full of adventure as any in the history of the state. Medical reports, diaries, addresses, newspaper clippings, and personal correspondence of early physicians, now in the possession of the Arizona Pioneers' Historical Society at Tucson, are ready to provide endless material for presentation by historians and storytellers.

Among the first medical men to enter Arizona were those who came with federal exploration parties. These men not only treated the ills and bandaged the wounds of the explorers, but also served as naturalists, collecting plant and animal specimens wherever they went. Several species of plants and animals are named for some of the first physicians to enter this area. The pink-flowered *Phylox woodhousei*, for example, and the common toad, *Bufo woodhousei*, were discovered by and named after Dr. S. W. Woodhouse, physician and naturalist who accompanied Captain Lorenzo Sitgreaves and twenty men in 1851 on the first official survey across northern Arizona.

In those early years, and into the middle of the nineteenth century, numerous army, mining, and religious camps were established in the Arizona Territory. Many had medical centers of sorts, usually pitifully equipped and understaffed.

Nevertheless in 1886, Arizona's commissioner of immigration, Patrick Hamilton, started propagandizing the Arizona climate in an effort to bring more people to the Territory. His book, *Arizona for Homes, for Health, for Investments* contained a section by Dr. M. H. Matas of Tucson and Dr. D. J. Brannen of Flagstaff, entitled "Arizona as a Sanitarium." E. H. Peplow Jr., in his *History of Arizona*,

states that Mr. Hamilton's promotional material had a lot to do with the fact that early in its career the state "achieved the reputation of being a panacea for all ills which were aggravated by dampness; asthma, respiratory ills of all sorts, arthritis, rheumatism . . ."

With this aspect of Arizona emphasized more every year, a number of rest homes and health clinics, especially those designed for tuberculars, were established through the cooperative efforts of physicians. The more rugged type of physician might be attracted to one of the several army installations such as Fort Whipple. That almost all early physicians needed to be rugged is revealed by the surgeons reports from such installations, describing the hardships besetting personnel who tried to work with the pathetically inadequate facilities.

Good climate and promotion notwithstanding, malaria epidemics developed in a number of Arizona valleys — for example, the San Pedro. A settlement without a medical center presented difficult problems. Dr. W. F. Whitmore tells of Dr. H. A. Hughes who performed the first major surgery in the Salt River Valley in 1888, stating that Dr. Hughes ". . . after a critical survey of the interior of the house, elected to take his chances with Mother Nature and operate beneath a cottonwood tree in the yard." He goes on to say, "Surgery was usually of the emergency class and demanded much resourcefulness and good judgement."

Another famous physician was Dr. George E. Goodfellow of Tombstone, whose adventures from 1880 to 1891 make an exciting narrative. Known as "El Santo Doctor" to the Mexican people, and respected by some of Tombstone's most hardened characters, he distinguished himself in the field of surgery, performing the first appendectomy in the Territory and perfecting other surgical techniques under very primitive conditions.

In 1892 a group of sixteen physicians, (one each from Gila Bend, Mesa, Tombstone, and Tucson, two from Tempe, and ten from Phoenix) founded the Arizona Medical Association, now the official medical body of the state. In 1912 the Association first published the *Arizona Medical Journal* which has since become *Arizona Medicine*. The group of sixteen has grown to 1010, according to the *Arizona State Medical Directory for 1960*.

Arizona's present-day physicians are trained to the highest levels of modern medical and surgical practice and are active in medical and science associations both nationally and internationally. As His-

torian Peplow pointed out "... the state today has one of the highest ratios, if not the highest, of doctors per capita in the country. This is due, of course, to the fact that so many people come to Arizona for health reasons ... The presence here of so many people who contracted an illness elsewhere tends to make Arizona appear considerably less healthful than it actually is."

This slight paradox aside, the level of health in Arizona is effectively maintained and steadily improved by the presence of so many excellent practitioners of medical science.

MEDICAL TECHNOLOGY. Medical technologists are professional workers who contribute invaluable service to mankind as strong right hands of the physicians and surgeons. They are a vital part of the team constantly crusading for better health and welfare for mankind. The first organized meeting of clinical laboratory workers in Arizona occurred May 17, 1939. The meeting was held in Tucson at the State Public Health Laboratory. The purpose of the meeting was to discuss the division of work of the private and public health laboratories, and to promote the interest, welfare, and efficiency of the laboratory workers. This first organization, which was comprised primarily of laboratory workers from the Tucson area, remained in existence until October 17, 1953, when the first annual convention and organization meeting of the Arizona Medical Laboratory Association was held in Phoenix. This provided an official organization on a state-wide basis which has been actively engaged in an effort to provide better medical services for the people of Arizona.

A third organization, the Arizona Society of Medical Technologists, initiated corporation proceedings and the drafting of a constitution and by-laws in November, 1953. The objectives of this organization were "to promote higher standards in clinical laboratory methods for research; to elevate the status of those specializing in medical laboratory techniques; to create mutual understanding and cooperation between the medical technologists and the physician ... and to promote the mutual aid and understanding between its members." The first organizational meeting was held in Phoenix on September 20, 1954, with twenty-four individuals in attendance. The organization was not officially recognized until it received its charter at the national convention of this society in June, 1954. Recently, the Arizona Society of Medical Technologists established two local chapters within the state. The Tucson chapter

received its charter in April, 1959, and the Phoenix chapter, in January 1960. The local chapters were formed in an effort to provide association and fellowship for more medical technologists through bi-monthly meetings of an educational nature.

The rapid growth and increase in population in the state of Arizona has brought about a need for more medical services of all kinds. In addition to the increased need for physicians, nurses, dentists, and physiotherapists, there is also a need for a substantial increase in the number of medical technologists in the state. At the present time, Arizona State University at Tempe, and the University of Arizona at Tucson each offer a four-year curriculum in medical technology leading toward the Bachelor of Science degree. The students in medical technology complete three years of undergraduate study in the basic sciences, social sciences, and humanities on campuses of these universities and the fourth year in schools of medical technology approved by the Council on Medical Education and hospitals of the American Medical Association. This cooperative arrangement is highly desirable in that the hospital schools are better prepared to supply the necessary clinical material and experiences to the student. In the Phoenix area, courses in medical technology are offered in the laboratories at St. Joseph's, Good Samaritan, and Memorial hospitals and, in the Tucson area, by Tucson Medical Center and St. Mary's Hospital. The training and academic requirements for medical technologists in the universities of this state are considerably higher than those required at the national level. The universities require the completion of courses in basic sciences, social sciences, and humanities in order to satisfy the degree requirements of the College of Liberal Arts and with this background, it is possible for the student to continue graduate study in some area of the basic sciences upon completion of the requirements for the Bachelor of Science degree.

NURSING IN ARIZONA. Nursing developed in Territorial Arizona, as in other parts of the world, in response to human need. Consequently the first persons giving nursing care in Arizona were essentially untrained. They worked in a matrix of pioneer, Indian, and Mexican cultures. They were limited by the existence of folklore, the level of medical practice at the time, and the health problems peculiar to the area. Folk and household remedies played their roles of comfort and questionable therapy. And the "nurses" who gave unstintingly of time and energy

were expected to combine with their nursing skill the arts of cook, seamstress, teacher, social worker, and midwife.

Miss Lunette Ready, who came to Phoenix from Chicago in 1894, is credited with being the first "trained" nurse in Arizona. Fifty nurses were reported in 1900 and their growing group-consciousness was reflected in 1918 when two associations were founded, one for Phoenix and one for Tucson nurses. They combined in a state association one year later, developing standards for nursing, and worked for the passage of the nurse registration bill which became law in 1921.

Education for nurses in Arizona began at St. Joseph's Hospital in Phoenix in 1910, at St. Mary's in Tucson in 1914, and at Good Samaritan in Phoenix in 1924. Added to this source of nursing graduates are the two collegiate schools of nursing, one at the University of Arizona, the other at Arizona State University, both established in 1956 by authorization of the Board of Regents. This expansion of the state facilities came forty years after the first degree program in nursing was organized in the United States. Phoenix Junior College established an associate degree program in 1959, bringing the number of Arizona schools of nursing to six.

In 1961, Arizona's institutions are expected to produce approximately 300 graduate nurses. This, in 1957, was regarded as a reasonable minimum for a population of 100,000. However, Arizona now has well over one million people, so the deficit has become enormous.

Another problem lies in Arizona's lack of graduate training for nurses. One nurse in ten needs a master's degree to enable her to function as administrator, supervisor, or teacher. To date, there is no available training in the state for these graduates, and no nurses from Arizona have taken part in the voluntary arrangement between Western states for students to receive professional education outside their own states.

Nursing service in Arizona has in fact been on an emergency basis since the beginning of World War II. Professionals in the field agree that the need for nurses will become more rather than less acute in the near future. Even though progress has been made in education, and in the quality of nursing personnel produced, the urgent need remains for Arizona as a state, assisted by national and regional resources, to determine and fulfill its responsibility with respect to the nursing profession.

PHARMACEUTICAL SERVICES. The rapid strides of pharmaceutical services from pioneer to modern standards are nowhere more observable than in Arizona, where the distance has been traversed almost entirely within the life span of a single, aggressive generation.

The pioneer druggist in Arizona as elsewhere was a compounder of medicines from crude and refined herbs, chemicals and oils, laboriously prepared by mixing, scraping, and pounding in a mortar, emerging finally as handmade pills, suppositories, ointments, and plasters. Most Arizona drug sales were in local coin such as the Spanish *dos reales* coin — or standard "two bit" piece. Higher-priced items were the green paper boxes of opium and morphine sold across the counter in pre-Harrison Act days at one dollar per box. The pharmacist in Territorial Arizona might also be called upon to double as physician and nurse, when quick-trigger sheriffs ordered survivors to the drug shop for patching up.

The modern era in Arizona pharmacy started in 1904, with the first Territorial pharmacy law establishing the Board of Pharmacy, later associated with the national association. Previously druggists had qualified by "inclination" only. The new law required candidates to pass a state board licensure examination. Such legislation had begun in South Carolina in 1817, formal pharmaceutical education in 1821 in Philadelphia. By 1900, there were sixty colleges of pharmacy in the nation. Although sought much by people still active today in the profession, Arizona's College of Pharmacy at the University of Arizona was not established until 1947.

In spite of its newness, Arizona's College of Pharmacy in 1951 was among the first four in the nation to advance its facilities beyond the four-year level. Further distinction came when Phoenician Newell W. Stewart in 1953 became president of the American Pharmaceutical Association.

The state now has 370 registered pharmacies, operated by state licensees who have college degrees. The average of one pharmacy to 3000 population compares most favorably to the national average of one per 3300, a fact which can probably be explained by Arizona's prominence as a health center.

The strong current of modern technology in the last fifty years has carried Arizona's pharmacists with those all over the nation into a different phase of the profession. The majority of pharmaceuticals are of course no longer compounded by hand. Manual compounding has declined from nearly 100 percent

of all prescriptions dispensed in 1900, to about 5.5 percent in 1959. With nearly all medicinals sold in final dosage form by pharmaceutical manufacturers, the retail pharmacist has become a supplier of such products, with the information about them, to physician and patient. He must also serve often as a source of general health education to the community.

There are 879 pharmacists licensed to fill these roles in Arizona. Sixty-five of them, or 7.3 percent, are women, compared to the national average of 6.7 percent. Arizona's averages differ from the national also with respect to the percentage of pharmacists retired or engaged in other business — 8.4 percent here and 6.8 percent nationally; the percentage involved in retail ownership — 35 percent here and 50.2 percent in the rest of the nation; in wholesaling and manufacturing, less than 1 percent in Arizona and 2.47 percent nationally; and in age — a smaller percentage of Arizona pharmacists are under forty years of age than in the rest of the United States.

Arizona joins with other states in licensing pharmacists from out-of-state by reciprocity. Because of the late development of educational standards for pharmacists in this state, Arizona leads the six states in which reciprocity results in more registrations of pharmacists than does regular registration.

In general, Arizona pharmacists are vigorous participants in professional matters within the state and beyond, and national leaders have expressed interest in the accomplishments of the profession and its practitioners during the short years of its history.

Social Services

These services are carried on in Arizona through county departments of public welfare, local sectarian and non-sectarian social welfare agencies, the Arizona Employment Security Commission, the federal Social Security Administration, county probation departments, private and public social and correctional institutions, and state parole systems. Also in the social service category are the various plans for unemployment, old age and survivors, and disability insurance.

Probably the earliest welfare work in Arizona was concerned with the protection of children. As far back as 1691, Father Kino was providing Indian youths in the missions at Guébavi and Tumacácori with protection, and training in religion, agriculture, and habits of industry.

In 1864, the First Territorial Legislature adopted the Howell Code containing several provisions for

the protection of children. One of these concerned Indian children, who under the law might be indentured to an individual until age eighteen (for girls) or twenty-one (for boys). The law specified that the individual seeking to have a child indentured must apply to a judge of the probate court, promising to provide humane treatment, proper food, and clothing, and not to transfer the indenture to another party.

The Howell Code further charged the several counties with providing for the "blind, lame, sick, aged, decrepit, or other disabled or enfeebled, so as to be unable to maintain themselves." Such persons could apply to a justice of the peace who might pay up to twenty dollars per month to any person from a county poor fund.

Until the State Board of Social Security and Welfare was created, public aid to the needy in Arizona was administered by a variety of state and county agencies. As facilities were limited, the indigent sick often were privately attended at the expense of the county.

In 1909, the legislature created a state board of control with a measure of centralized authority over various public welfare agencies. The law provided for three board members — the governor, the auditor, and one citizen appointed by the governor — who were given full charge over charitable, penal, and reformatory institutions then existing or later to be established. The functions of this board were not confined to overseeing these institutions, but included other powers and responsibilities as well.

During the depression of the thirties, Congress established the Federal Emergency Relief Administration. The Arizona State Board of Public Welfare was accordingly created to enable the state to receive federal funds from this program. The board administered federal, state, and county funds, and supervised services for the indigent ill, dependent children, and paupers.

In 1935, the Social Security Act was passed by Congress, and federal funds were made available to Arizona on this basis in 1936. In 1937, the Thirteenth Legislature abolished the State Welfare Board and by an emergency act created the State Board of Social Security and Welfare. In 1948, the name was changed to the Department of Public Welfare.

This department is the largest social welfare agency in the state and is responsible for interpreting social service to the public. Although Arizona lacks many facilities enjoyed by older states, the social

legislation has been broad in scope and frequently needs only more complete financial implementation.

The statute setting up this department provides also for county boards of public welfare consisting of three members appointed by the county board of supervisors and under direct supervision of the state department to perform such duties as the state may prescribe.

The county departments of public welfare, under supervision of the state department, administer all state and federal social security programs at county levels. These programs affect the aged, the dependent children, the needy blind, and child welfare recipients. County departments also administer state aid through funds for general assistance, temporary assistance, emergency relief, and for foster homes and institutional care. The case load is the basis of fund allocation to these projects.

The Department of Public Welfare in each county includes the divisions of Child Welfare, Crippled Children, and Public Assistance. These divisions have a structure and *modus operandi* generally comparable to other such agencies throughout the United States. The Child Welfare Division employs the foster home plan, and also works through institutions as the Florence Crittenton Home and Convent of the Good Shepherd at Phoenix.

Among its welfare agencies and apart from its general public assistance program, Arizona has also the Veterans' Service Commission which services disability and pension claims for war veterans, and the Arizona Pioneers' Home and Hospital for Disabled Miners. The only other institution similar to the latter in the entire United States is Alaska's home for the aged survivors of gold rush days.

The Pioneers' Home at Prescott was established by the Twenty-Fifth Territorial Legislature in 1909, and the building was completed in 1911. Original accommodations provided for forty residents.

The will of W. C. Parsons, a Yavapai County mining man who died in 1914, established a trust fund for an addition to the Home for women pioneers. This section was completed in 1916 and provided for twenty residents. In 1925, the legislature appropriated \$17,000 to be added to the revenue from the Parsons fund for a Pioneer's Home Trust Fund, to carry out additions and improvements to the home.

The Disabled Miners' Hospital was established by legislation in 1929, intended for those who had been active in mining in Arizona. It is now an in-

tegral part of the Pioneers' Home with both institutions under one superintendent and one legislative appropriation. In recent years, anyone qualifying for admission to the home can be admitted also to the hospital.

Private welfare services in Arizona are carried on by religious organizations, sectarian and non-sectarian, and by private and community chest funds and specialized institutions financed by fees and endowments. Among such agencies are the Catholic Social Service, the Jewish Welfare, the Salvation Army, the American Red Cross, and Family Welfare, a private non-sectarian family service agency.

Organizations in Arizona supporting and carrying on private welfare work for many special groups include Friendly House in Phoenix, which offers guidance to aliens and an Americanization program for Spanish-speaking residents; the Boy Scouts and Girl Scouts throughout the state; the Young Men's Christian Association and Young Women's Christian Association in several communities; the Arizona Children's Home Association, a private care-child institution in Tucson; the Florence Crittenton Home in Phoenix for unwed mothers; and the Ryland Home near Tucson for aged men who are recipients of public assistance.

In the field of social insurance, Arizona has all the services and agencies common to the various states since the inception of the federal Social Security Act. The State Employment Service and Unemployment Compensation Division are administered by the Employment Security Commission. Old Age and Survivors' Insurance, and disability insurance are provided by the federal government and administered at state level.

Correctional Services

Closely related and often running parallel to social services in Arizona are the correctional services which include probation, institutional care, and parole. Probation for adults and juveniles is administered on a county basis. Two of the three correctional institutions, the Arizona State Industrial School, and the Arizona State Prison are publicly administered. The third, the Convent of the Good Shepherd, is privately administered. Adult and juvenile parole is a state function, administered by the Board of Pardons and Paroles for adults and by the Board of Directors of State Institutions for Juveniles.

Juvenile courts and Superior Courts in all counties of Arizona have made provision for some form

of probation service. Most counties have only one man assigned to the supervision of both adults and juveniles, however, and while more populated counties do have larger staffs, only one county has separate personnel for adults and juveniles. Probation officials in the state express the need for expansion of this service and for private social agencies to buttress the probation service.

In Arizona as in many other states, juvenile detention is a continuing problem. Detention is the temporary care of children in physically restricting facilities, pending court disposition or transfer to another jurisdiction or agency. Three counties in Arizona have detention homes which are in separate buildings with regular staffs under juvenile court jurisdiction. Three other counties provide detention quarters which are under the control of the jail staff, although not directly connected with the county jail and having separate entrances. In the remaining counties juveniles who must be detained are placed in the county jail. Officials in this field look forward to an implementation of existing state statutes which require all counties to provide separate facilities for juveniles.

Adult probation services are operative in Arizona but are thus far regarded as inadequate. Pre-sentence investigation to ensure the success of probation, for example, is carried on in only three counties.

Only 20 percent of officers handling adult probation cases have a partial college education. Sixty percent have completed high school education, and 20 percent have completed grade school. For individuals working in these jobs case loads are excessive and salaries at the present time are considered low.

Among Arizona's correctional institutions, the State Prison has a colorful history. Before the Territorial Prison was established at Yuma in 1876, convicted offenders were held in various jails throughout the Territory. Considering that Arizona in those days was a congregating point for some of the boldest desperadoes in the nation, the facilities for imprisoning offenders were notably inadequate.

In 1867, an act of Congress provided for a penitentiary to be constructed in the Territory, leaving the choice of location up to the Legislature. Phoenix was selected in 1868, but nothing more was done until 1876 when the location was shifted to Yuma and construction of the prison was started.

On a granite bluff overlooking the Colorado River, with desert for hundreds of miles in all direc-

tions, the site seemed ideal for imprisoning maximum security offenders. The prison started with seven inmates and at a later date had 376, many from distant parts of the country.

From the standpoint of the prisoner, Yuma was not popular. The heat of the summers and bleakness of the terrain were matters of dread. Prison escapes were frequent in spite of isolation and the cooperation of local Indians who were paid fifty dollars for each escaped convict they apprehended.

The prison proper was little more than an open corral surrounded by a thick adobe wall with watch towers on each corner. The prisoners were locked in long tiers of rock-built cells at night, but there was little to hinder their escape by day except the rifles of the guards and the pepper-box Gatling gun mounted in one of the corner towers.

In 1907, the legislature decided to move the prison to Florence and appropriated \$120,000 to construct several modern buildings on a site near the city. The title to the old prison lands returned to Yuma and the offices of the city government were placed within the old adobe walls. The former prison hospital was used to house the first high school in Yuma and from this the present Yuma High School football team derived its name, "The Criminals."

In 1909, the new Territorial prison was constructed and soon after acquired its present status as Arizona State Prison. Insufficient space is probably the chief problem of this institution today, coupled with the closely related problem of keeping the prisoners constructively occupied. Built to accommodate 600, the prison has at times had 1200 inmates. It is the only major penal institution in the United States receiving all offenders confined to prison for all types of crimes. Thus the institution is serving purposes normally served by three or four separate physical plants: the main prison, the Institute of Educational Rehabilitation, the trusty section, and the women's section. Segregation of these facilities has been achieved, but not separate or adequate facilities.

The history of the Arizona Industrial School goes back to 1891. Governor Murphy urged the legislature to provide a reform school for "vicious youth of both sexes." At that time in Arizona, youthful offenders could be placed nowhere except in jails or the penitentiary, and the citizenry felt an urgent need for a juvenile industrial school.

In 1893, the legislature empowered the governor to appoint a board of trustees to select a site and

plan suitable buildings. Flagstaff was chosen and construction started. By 1897, after more than \$33,000 had been spent on construction, the authorities decided against Arizona having such an institution and the new building was made into a normal school in 1910.

Various proposals followed for solving the problem of youthful delinquents, and in 1903 the Territorial Industrial School was opened at Benson, housing both boys and girls, although on a segregated basis. By 1912, the school population was overtaxing the building's capacity, and a commission was appointed by the legislature to select a suitable new site. Fort Grant was chosen and a federal enabling act secured. The building at Benson was leased to the town for use as a high school.

The present State Industrial School at Fort Grant is situated on 3900 acres with fifty-five acres under cultivation and three acres in orchards. Most of the physical plant is only six years old, many of the fort's original buildings having been replaced. Major structures include the administration building, school and gymnasium, four dormitories, repair shops and garage, infirmary, industrial arts building, dairy, laundry, kitchen-dining unit, warehouse, maintenance shops and twenty staff homes and bachelor quarters. Under construction are two dormitories, a recreation building, and a combination garage and maintenance shop. The school receives boys aged twelve to eighteen when committed by juvenile court.

Provisions for girls at Fort Grant proved unsatisfactory and various proposals for change were considered, but no action taken until 1927. A separate school for delinquent girls was completed in 1929, but due to high cost of operation abandoned in 1933. Girls were then sent to the Florence Crittenton Home and similar institutions. Now these girls are for the most part received by the Convent of the Good Shepherd in Phoenix, with their care paid for from state funds.

The original Convent of the Good Shepherd was founded in France over 300 years ago by members of a Catholic sisterhood. Today it operates homes for delinquent girls and prisons for women in all principal countries of the world. All convents are governed by the original "mother house" in France, and those in the United States are grouped under six provinces, the one at Phoenix being in the St. Louis province.

The curriculum of the school at the convent is the same as that of Arizona public schools. Industrial training is given in steam press operation, laundry and office work, and domestic science. The school has a full-time social worker, a part-time clinical psychologist, and a consulting psychiatrist on the staff.

Built to house about 104 girls, the institution can expand to accommodate 180. Inmates are girls between the ages of twelve and eighteen who are considered by society to be morally delinquent.



..... *highways*

SPEEDING ALONG A PAVED HIGHWAY ACROSS THE Arizona desert, one wonders how the pioneers could have made their way through such forbidding country, barren of sustaining vegetation and with no visible source of water. However, in the pioneer period many of the streams which are now wide, sandy channels, dry most of the year and carrying only flood water, were smaller and ran continuously. Fish ran in the streams, lush native grasses grew along the flood plains, and even some of the uplands provided good grazing. A natural erosion cycle which began in the 1890's, together with overgrazing by cattle and sheep, killed much of this grass, destroying the roots which held the soil in place, thus allowing the summer rains to wash the soil away. But even under the somewhat better physical conditions of those early days, travel into and across the area now designated as Arizona was most difficult. Today, conditions of travel are far different. Not only are there excellent transcontinental routes, but roads within the state interconnect the major cities and vacation spots. As in the experience of older states in the Union, so in Arizona the network of highways represents a joint activity of the federal and state governments.

In 1866 the Territorial Assembly authorized the county boards of supervisors to divide the counties into road districts and to appoint overseers to levy a road tax not to exceed five cents per hundred dollars valuation, and a poll tax not to exceed six dollars per able bodied man. Two days labor on the roads could be substituted for the poll tax payment. Later legislative acts authorized the counties to issue bonds for road construction. Territorial bonds for

road work were issued for \$70,000 in 1877, for \$15,000 in 1885, and for \$19,000 for a bridge across the Gila at Florence in 1905. A Territorial engineer was appointed in 1909. But the construction and maintenance of roads was primarily the responsibility of the counties during Territorial days and for a considerable period thereafter.

Beginning in 1871, toll road companies were permitted to incorporate under county authority. Requirements were in general the same as for incorporation under Territorial authority, except that the county could, after five years, purchase the toll road at its appraised valuation. Two percent of the gross proceeds from all toll roads went into the Territorial school fund. There was also a regulation to the effect that if, after three years of operation, the net annual proceeds from any toll road exceeded 50 percent of the cost of the construction of the road, the excess above 3 percent would go into the Territorial school fund. All toll roads were under the supervision of a commissioner who reported to both the governor and the Assembly.

When Arizona became a state in 1912, the title of territorial engineer was changed to state engineer. The state engineer was under the Board of Control until 1917, under the Commission of State Institutions until 1919, then under the Board of Directors of State Institutions until 1927, at which time the Arizona State Highway Commission was established. Prior to 1922, the state engineer operated more or less as a stepchild, improving and maintaining such roads as seemed most needful, to the limit of the funds which might be furnished him. If he spent any money in improving a road, it was considered

a state highway. If he ceased maintaining it, then it ceased to be a state highway. Counties were authorized in 1909 to levy from five to twenty-five cents per \$100 assessed valuation for road purposes, the rate to be decided by the counties on basis of need. This act was superseded in 1912 when the legislature voted a property tax levy sufficient to raise an annual road fund of \$250,000, of which 25 percent was to be expended on state roads and 75 percent returned to the counties in proportion to collections. This tax remained in effect until 1917, at which time the law was modified by a general tax levy of ten cents per hundred, of which 25 percent was for state roads and 75 percent for county roads. Though the revenue laws were revised by the legislature from time to time, this 10 per cent per hundred property tax continued to be collected until 1933, at which time the raising of funds by property tax for highway purposes was discontinued.

Soon after Arizona became a state in 1912, a number of significant things occurred which presaged the end of the period of toll roads, poll and property taxes for the support of road programs, and the responsibility of the counties to bear the major burden of providing roads for the rapidly increasing traffic demands. These were the passage of the Federal-Aid Act of 1916 and the gasoline tax of 1921, the establishment of the State Highway System of 1922, and of the State Highway Department under a State Highway Commission in 1927.

Federal Aid

World War I brought to the attention of Congress the woeful inadequacy of the roads in the United States as a means of transport during emergency. There were few good roads and no system at all. To correct this, the Federal-Aid Act was passed in 1916. An initial appropriation of \$75,000,000 was made to be allocated to the states on a basis of population, area, and mileage of post roads, provided the states would match the allocation on a fifty-fifty basis. Then there were other requirements. To participate in this program, a state had to set up a comprehensive and adequate system of highways equal to 7 percent of its total road mileage. To prevent the far-reaching effects of unwise decisions, which sometimes occur because of local political pressures, and to insure that the systems of the several states would connect in such a way as to form a satisfactory national system of highways, approval by the U.S. Bureau of Public Roads was made necessary before

any funds would be allocated. Other requirements were the formation of an adequate state highway department, headed by an experienced and competent civil engineer, the approval by the Bureau of Public Roads of all construction plans on projects upon which federal funds were to be spent, and a guarantee by the state that such projects would be adequately maintained.

A division office of the U.S. Bureau of Public Roads was established in Arizona in 1919. This office does not initiate road projects nor does it do the engineering work in connection with road projects, except an occasional project such as the Hitchcock Highway into the Catalina Mountains, which was built by federal prison labor. Its responsibility is to examine and approve or reject plans and specifications of all road projects for which federal funds are requested by the state, counties, cities, the Bureau of Reclamation, or the Indian, Forest, and Park services. All projects upon which federal funds are to be expended must be submitted to this office, whether they are highway systems, road locations, research work, bridge work, or road construction.

The Federal-Aid Act was modified and clarified by the Federal Highway Act of 1921. Without the passage of these acts, and subsequent revisions and additions, highways as an adequate facility for transportation simply would not exist. The states and counties could not have done the job. Over the years many appropriations have been made by Congress in support of the federal aid program. But, except for some special appropriations during the Depression, the federal government has collected from the highway users, in one tax form or another, funds equal to or greater than the total of federal aid appropriation.

The initial 7 percent Federal-Aid Primary System (FAP) proposed by the Arizona Highway Department was approved in 1922. Subsequent actions raised this to 8 percent. The interconnections of the primary systems of the several states enabled the federal government in 1925 to designate a federal system of highways. These are the highways marked with the United States shield. They are not really federal roads, but are connected state primary roads designated as U.S. Highways.

The Hayden-Cartwright Act of 1934 stipulated that 1.5 percent of the federal funds allocated to any state should be used for engineering, economic, and planning studies. In conformance with this act, the Arizona Highway Department in 1936 established

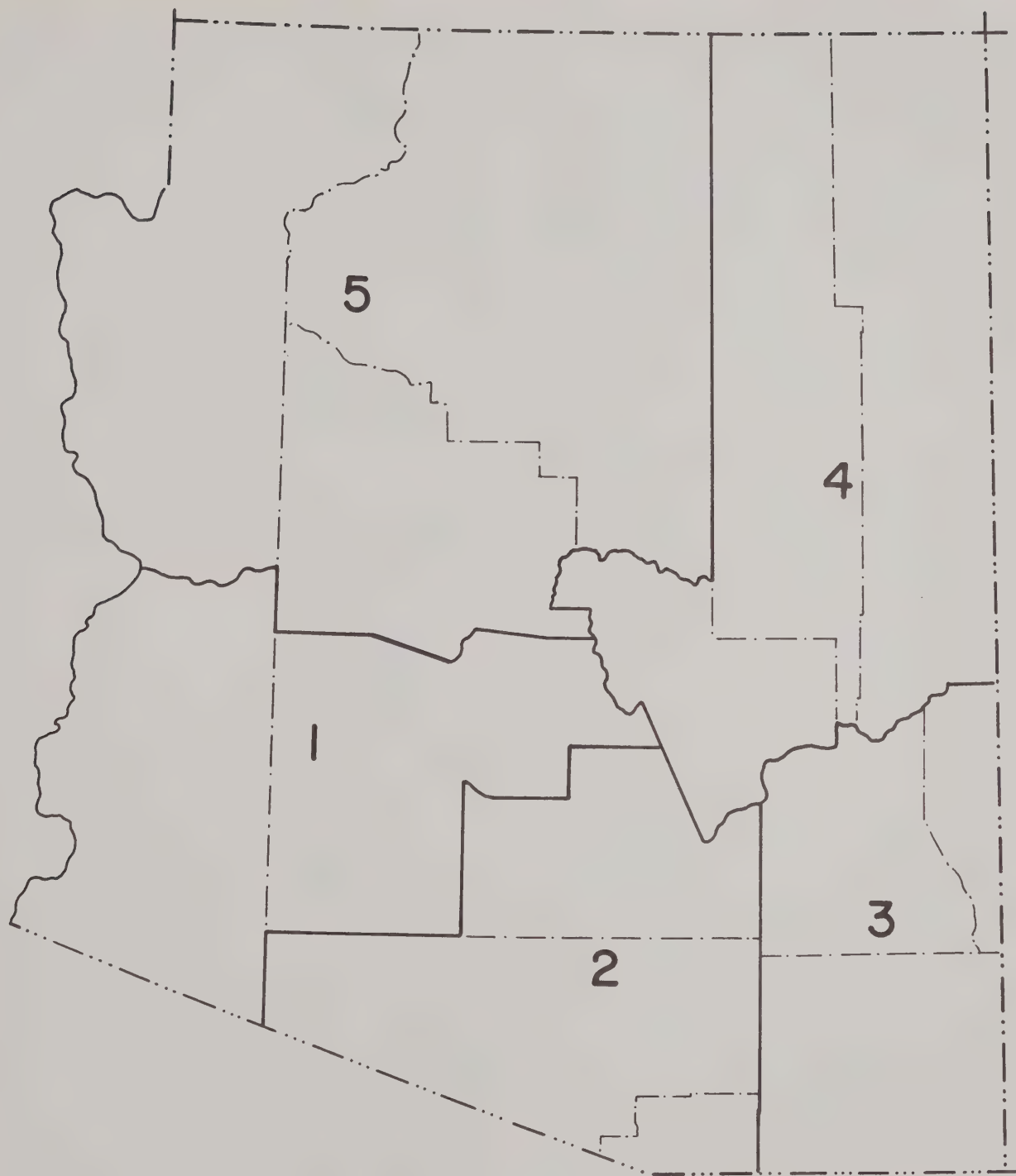


Fig. 1. Map showing the districts which the five highway commissioners represent

a Planning Survey Division where William E. Willey, now state engineer, devised a method known as "Sufficiency Rating," by means of which it can be determined scientifically how and where to apply

most advantageously the currently available funds. Inasmuch as there are never enough funds currently available to make all the needed highway improvements, a choice must be made. Application of the

"Sufficiency Rating" enables the state engineer to present the facts to the Highway Commission. Many other states are now using this formula.

Subsequent Congressional acts provided for the states to set up a Federal-Aid Secondary System (FAS) on which federal funds could be spent. Many important county roads could be included. An urban system (FAU) was also approved. The ratio of matching funds was changed from fifty-fifty to sixty-forty, with the federal government contributing the larger amount, and with a provision that in those states containing a large amount of public land, the federal participation would be raised. In Arizona the federal government contributes 72 percent and the state 28 percent.

The 1956 Federal-Aid Highway Act not only continued the FAS, FAP, and FAU support at an increased rate, but also made provisions for a national system of superhighways to cross all states. These strategic highways will reach all major cities and defense plants, and in general, form a system of importance in the defense of the country, as well as carry the heavy load of transcontinental motor transport. The matching funds on this system will be on a 90-10 percent basis, but in Arizona, because of its large area of public land, the basis will be 94.6 percent federal, and 5.4 percent state. Motorists, not the real property owners, will pay for these highways.

The most significant act of the Arizona Legislature relating to highways was the passage in 1927 of an act which set up the Arizona State Highway Commission of five members, with broad powers to establish a highway system and a highway department, to employ a state highway engineer, and, in fact, to determine all matters concerning highways. The whole burden of the actual operation of the department was on the shoulders of the state highway engineer under the original arrangement, but by a later legislative act, the executive secretary of the commission was vested with authority, under the commission, on all except technical matters. These remained under the state engineer. The first commissioners were appointed without consideration of residence, but later the state was divided into five districts, with one commissioner from each district. These districts are marked on Figure 1. Figure 2 shows the State Highway System as it was officially approved by the Highway Commission in 1927. At that time, the system contained a total of 1,988 miles of roads, of which 219 were paved, 869 gravelled, 758 graded, and 142 unimproved. In 1957, the

system included a total of 4,328 miles, of which 2,325 were Federal-Aid Primary, 1,730 Federal-Aid Secondary, and 193 non-federal-aid. These are shown on Figure 3, which also shows that most of these roads in the state system are paved. Although the state system includes most of the important highways, its mileage amounts to only 14 percent of all the roads in the state; however, this 14 percent carries over 50 percent of the state's traffic. Arizona roads in other jurisdictions are classified as follows:

Classification	Mileage
Counties	16,557
Incorporated places	2,105
Indian Service	4,152
Forest Service	3,742
Parks and Monuments	667

These roads, when added to the other mileage, totaled 31,371 miles in 1957.

As of January 1, 1957, road conditions in Arizona, including all classifications, were approximately as follows:

Condition	Mileage
Paved	5,698
Surface treated	2,638
Select soil or gravel	5,478
Graded and drained	4,490
Unimproved	13,105

It should be noted that the miles paved are greater than the total mileage of the State Highway System. While it is true that there are a few miles in the state system not yet paved, the over-all picture indicates that all of the main traffic arteries in the state are paved. **THE U.S. INTERSTATE HIGHWAY SYSTEM.** The new U. S. Interstate System of highways, authorized by Congress in 1956, will total about 41,000 miles of which 1,162 miles are scheduled to be built in Arizona. Two of the five major east-west arteries of this system will cross Arizona. One north-south artery will extend from Nogales to Flagstaff. The approximate location of these superhighways in Arizona is shown on Figure 3. The general design plan of these limited-access superhighways is four-lane, divided cross-section with numerous grade separation structures. Some sections are already under construction. About \$24,000,000 has been allocated to Arizona by the federal government for construction on this system for the fiscal year 1961.

Revenue and Federal Aid

FEDERAL AID. In compliance with legislative action, the state pledged itself in 1917 to match such

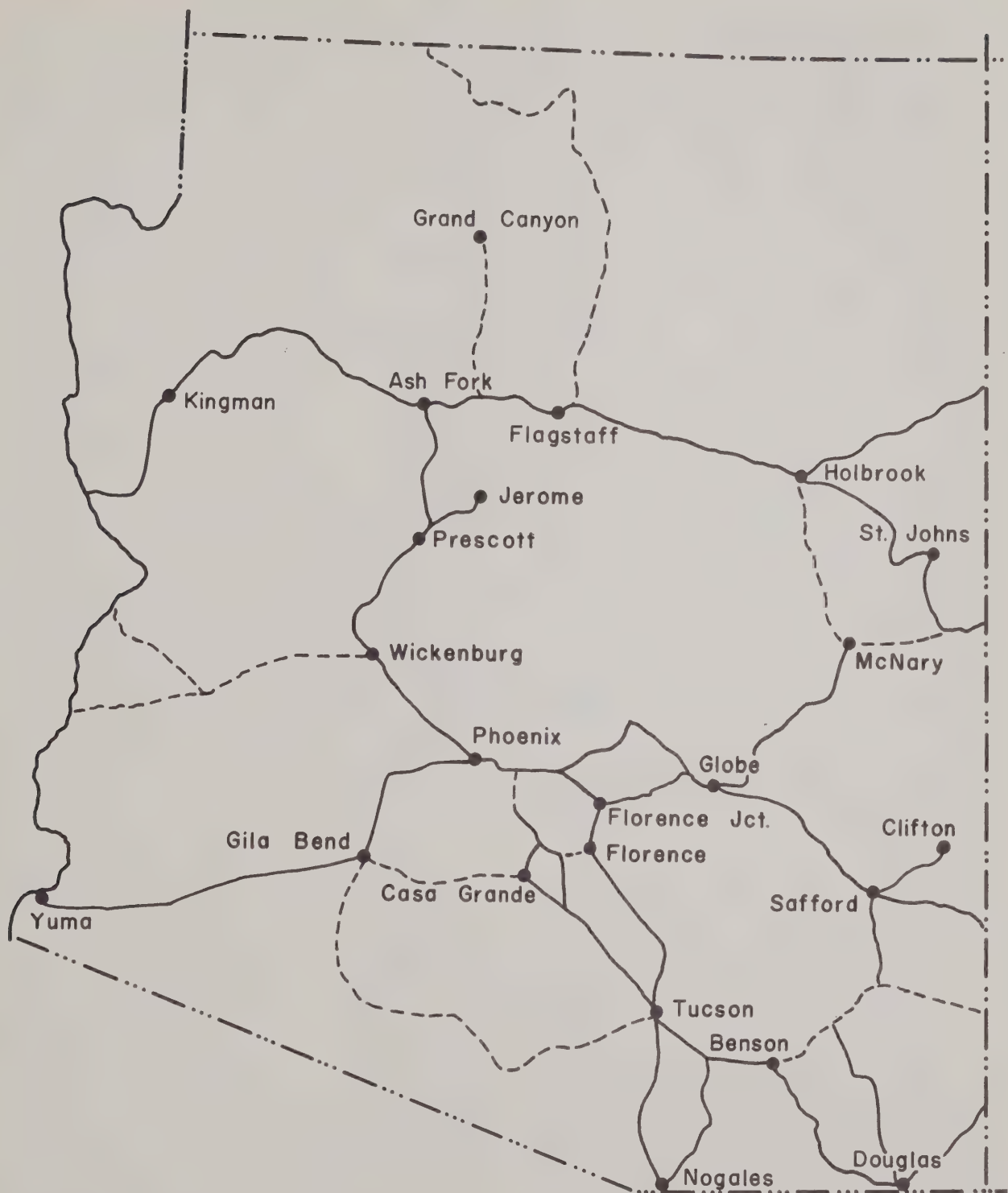


Fig. 2. Map showing the Arizona state highway system as approved in 1927

federal funds as might be allocated in the following years. The first project agreement was signed in that

year. It was for additional spans to the bridge over the Gila River at Florence. Bonds were authorized

for the construction of this bridge by the Territory in 1905. It was actually built in 1910 by prison labor but suffered flood damage in 1914 and was left high and dry in 1916 when flood water cut a new channel. The state has continuously availed itself of such federal-aid funds as have been allocated from year to year. Up to and including 1957, the state had received \$257,565,696 in federal-aid funds. Appropriations for Arizona for 1959 were:

Interstate System	\$22,843,956
Primary System (FAP)	5,714,323
Secondary System (FAS)	3,895,113
Urban (FAU)	851,554

GASOLINE TAX. In 1921 the state levied its first gasoline tax of one cent per gallon, the money to go into the state road fund. This tax was superseded in 1923 by a three cent per gallon levy, one-fourth of the funds accruing to go to state roads, one-fourth to the county road fund, and one-half back to the county in which collected. This was again superseded in 1927 by a four cent per gallon tax of which five-eighths was to go to the state road fund and three-eighths to be returned to the counties in proportion to sales made within the county.

The gasoline tax was raised to five cents per gallon in 1931. This tax was to be reduced to four cents in 1933, but this cut was not made. Again it was fixed at five cents, of which the state was to get seven-tenths and the counties the remainder. In 1932, gasoline distributors were required to obtain a license from the state at a cost of \$25 which went into the road fund. For 1957, the motor fuel tax amounted to \$19,700,798, of which two-tenths was returned to the counties where collected, one-tenth to the incorporated places within said counties, and seven-tenths to the state highway funds. The Arizona tax is five cents per gallon at present, and is the largest highway revenue source in the state. Currently, the federal tax is four cents per gallon, and the average state tax in other states is six cents per gallon. In 1957, Arizona collected tax on 368,596,664 gallons. The Hayden-Cartwright Act of 1934 stopped a practice which had become prevalent in many states of diverting gasoline tax to uses other than highways, by the simple expedient of withholding federal aid if this practice was followed.

MOTOR VEHICLE FEES. In 1913 motor vehicle operators were required to pay a license fee varying from \$5.00 to \$15.00, motorcyclists \$2.00, and chauffeurs, \$5.00. In 1921 a surtax was levied upon trucks up to a maximum of \$25.00. All of these

collections went into the state road fund. In 1923 a tax of one-half mill per mile, per passenger capacity, was levied against all highway common carriers, and a two mill tax per mile, per truck ton, on scheduled highway carriers. In 1925, motor vehicle registration with the Secretary of State for title was required at a cost of \$1.00. Duplicate plates to dealers were required at a cost of \$3.00 per pair, and used-car dealers were required to obtain annual licenses at a cost of \$5.00. In 1927 the rules concerning motor vehicles were definitely outlined, the major changes being the raising of the car license fee to \$3.50, and truck fees at varying rates from \$5.00 to \$40.00. These fees were to be collected by county assessors, the counties to retain fifty cents per car for this service. Common carriers of passengers were required to pay a license tax of 2 percent of gross receipts from operations within the state and other common carriers 2.5 percent. In 1931, the rates on commercial vehicle registrations were raised substantially in accordance with gross weight, tires and number of axles.

It should be understood that whereas federal funds are used only for construction, and planning research, the state's own funds must take care of the expense of maintenance, administration, policing, and other miscellaneous costs. It is estimated that the actual investment in the State Highway System, including both state and federal monies, was \$306,825,422 as of 1957.

Design

The path of least resistance was followed by the pioneers in crossing the Territory of Arizona. But when it became necessary to set up an adequate highway system to include all population centers, county seats, major industries, scenic attractions, to connect with major traffic arteries in contiguous states, and, in fact, to accommodate all of the state's population, the path of least resistance had to be forgotten and the roads located where the system required, regardless of difficulties. In one instance, where a temporary road had been constructed in Territorial days, a better location was later found and a new road built, but the search for the ultimate best location was continued over a period of thirty years. It was finally found after the science of photogrammetry was developed sufficiently to transfer the search to aerial photographs. Difficult mountain terrain adds enormously to the expense of construction of high standard roads. The great distances across



Fig. 3. Map of state and inter-state highways in Arizona, 1957

the barren stretches of desert add to the cost which must be met by a relatively small population. The only plan which could be followed in developing a good road system was that known as stage construction. First the road was located, then graded, then

gravelled, and finally paved, each step being taken when funds became available.

By 1927 most of the main arteries were gravelled. Beginning in 1928 Arizona utilized, as did other states, an inexpensive pavement type known as

mixed-in-place oiled gravel. As most roads were already gravelled, it was only necessary to add some more gravel, spray it with 60–70 road oil, mix it with a road grader, and let the traffic compact it. This was a notable development, one which enabled the state to cover most of its main traffic arteries with pavement at a cost equal to that of a few years maintenance of a dusty, dangerous, corrugated, gravel road. Those oiled gravel pavements which were laid in areas where the subgrades were solid, and unaffected by water, carried the traffic for many years without much maintenance. In areas where the subgrade was of the type that softened when wet, the pavements soon went to pieces. This type of pavement continued to be used for many years, a gravel base being placed under it in areas where the subgrade was poor. As traffic increased and funds became available, better types of plant-mixed asphalt pavements were used. Early pavements were mostly two-lane and eighteen feet wide. These widths were increased to twenty, then to twenty-two feet, and finally to a cross section road twenty-four feet wide, with an eight foot paved shoulder on each side. Today, broad four-lane divided arterial highways are being built across the state.

One of the expensive items of pavement construction on desert roads is the large number of culverts needed to bridge washes. In country which appears to be perfectly flat and level, washes which are normally dry but carry considerable water after rains, are often encountered at intervals of half a mile or less. In the early days of highway improvement, the pavement merely followed the contour of the land. As a result, dips in the road were an ever-present danger to the motorist. Most of them have now been bridged. The Interstate System of national highways will be built to high standards with broad, four-lane divided roadways, bridged washes, grade separation structures, and limited-access approaches.

Two county paving projects are noteworthy. In 1921 Maricopa County voted \$4,000,000 in bonds for funds with which to lay a gridiron of concrete pavements in the flat, irrigated lands of the Salt River Valley. This was the largest county paving project attempted in any county in the United States at that time, and it was widely reported in national engineering magazines. Many of these pavements are still in use. In 1932, Pima County constructed forty-two miles of mixed-in-place oiled aggregate pavement on East Broadway; aggregate crushed stone was used on one mile, and river-run gravel on the

other. The latter material proved to be quite superior, and it was used on all subsequent projects.

Mileage tabulation checks on the several classifications of roads in Arizona proved that county roads have the greatest mileage. The construction and maintenance of these roads make it necessary for the boards of supervisors to employ county engineers and set up departments for this purpose. Some of the departments in the more populous counties are quite large. To finance the operations of these departments, the counties receive two-tenths of the gas tax collected within their boundaries, plus one-tenth which goes to incorporated communities in the county. In addition, the counties receive one-half of the federal-aid funds allocated to the state for the Secondary Highway System. The state uses the other half for its Secondary System, which includes many roads of importance to the counties.

Bridges

In earlier days, good bridge sites were selected and the traffic detoured to the bridge. Now, except under unusual circumstances such as are presented by the Grand Canyon, the highway is located for the convenience of traffic, and the bridge erected where the highway meets the stream, regardless of the difficulties encountered. A case in point is the bridge built across the Salt River at Tempe. Former short span bridges used pony trusses, and large spans were of the through truss type. Now the short spans are of the girder type, and the long spans are girders supported by steel arches or piers. The old bridges were one or two lanes wide, whereas the new ones are as wide as the pavement, regardless of whether it is two-lane or four-lane. This type of construction is safer and more convenient for traffic, but adds enormously to the cost. The best estimate available at present indicates that about 800 new bridges will be required on the new Interstate System of highways in Arizona. Approximately 150 grade separations will be required for the freeways in Tucson and Phoenix. Thirty-one of these have been built, and ten are under construction.

Progress in bridge design includes the use of electronic computers in lieu of the old desk calculators. Welding and high-tensioned bolts have practically replaced rivets in steel structures. Much use is being made of shear connectors to produce composite action of wide-flange steel beams with concrete deck slabs. The long used cast-in-place concrete structure is losing favor to the newer precast-prestressed type.



— Chuck Abbott

Navajo Bridge over Marble Canyon on U. S. Highway 89

The three types of short-span bridges currently being designed for use in Arizona include the two types mentioned above, and the steel girder.

There are five interstate bridges in the Arizona Highway System, not counting the crossing at Hoover Dam. These are at Yuma, Ehrenberg, Parker, Davis Dam, and Topock. The bridges at Yuma, Topock, and Parker were built by the Department of the Interior which paid half the cost, the other half being shared equally by Arizona and California. The bridge at Ehrenberg was built by private capital as a toll bridge and later purchased by the two states. All of these bridges are jointly maintained by Arizona and California.

The Pinto Creek Bridge on Highway 70 near Superior, built in 1948, received the Institute of Steel Construction award for the most beautiful steel bridge built in that year. This is a 516-foot, deck-

girder bridge supported by a steel girder arch 350 feet long.

The Navajo Bridge, which carries the traffic of Highway 89 across the Colorado River at a point about six miles below Lees Ferry, was built in 1929 at a cost of \$260,000, of which the Indian Service of the Department of the Interior paid half. At this bridge site the solid rock walls of the canyon are vertical, about 600 feet apart and 600 feet high. A deck girder bridge, supported by a steel arched truss, was designed for this site. It was erected by anchoring the ends of the steel arch into the solid rock walls on each side and cantilevering the ends of the arched truss out until they met at the center of the span. This was a difficult and dangerous procedure, but about the only method which could be used at a site so high above stream.

The Colorado Bridge at Glen Canyon is an un-

usual structure built in 1957–1959 at a cost of \$4,139,277. The erection presented more difficulties than the design, though that was not simple. It is a deck-girder bridge forty feet wide and 1271 feet long, supported by steel columns. These, in turn, are supported by a steel arch truss anchored against the solid rock walls of Glen Canyon, which at this point are 1,028 feet apart. The deck of the bridge is 680 feet above the stream. The only possible way to erect the bridge was to cantilever each half from its skewback canyon wall support until the two halves met at the center. The steel truss members which formed the cantilevers were lowered into place from cableways anchored to towers on each side of the stream. The cantilever sections were so long that it was necessary to support them by ties from towers until connection was made at the center of the arch. In order to make sure of exact fit at the center of the steel truss, members were milled to one ten-thousandth of an inch, an unprecedented precision for bridge members, and a trial fitting made at the fabrication yard. A precise preliminary survey was also necessary under dangerous and difficult circumstances. The precision of this survey, made by men while dangling on ropes against the steep rock walls of the canyon, was equal to that expected of surveys made under normal conditions.

The hazards of highway construction in Arizona have not deterred the development of an excellent system of roads. Financed by federal and state money, these highways have come to be known by the tourists in Arizona. As an economic activity within the Arizona economy, highways have contributed much to the wealth and mobility of both citizen and visitor within the state.



— U.S. Bureau of Reclamation

Preparing skewback for Glen Canyon Bridge

..... *its economy*

A creative economy is the fuel of magnificence.

RALPH WALDO EMERSON

..... *a current appraisal*

THE ECONOMY OF ARIZONA, WHETHER ANALYZED in terms of the basic and complex interrelationships at a given time or considered in terms of the dynamic factors that cause change and growth, is obviously not a self-contained system. It is a part of the broader system affected by and, in turn, affecting the operation of the economy of the country as a whole. Indeed, the impact of world-wide economic and political influences are of peculiar significance to Arizona. Properly understood, of course, there is no such thing as the "economy of Arizona."

This does not mean, however, that considerable benefit cannot be derived from special attention to the most salient economic factors that affect the well-being of the people of Arizona. This special attention has to be given if the individual is to be governed by rational considerations in his own decision-making and if public policies are to be influenced by facts and rational conduct.

SOME GENERALIZATIONS. In the fifteen-year period since World War II, Arizona annually has held either first or second rank among the states in the rate of population growth; for the entire period it has been first among the states in both general and manufacturing employment growth, and in non-ferrous metal production, and second in the increase in income growth and increase in the value of farm production and bank deposits. For the decade between 1950 and 1960 Arizona was second among the states in population growth, with increase of 71.9 percent. These rapid rates of increase brought greater concentration of population, manufacturing activities, banking resources, and construction activities, especially in the Phoenix and Tucson com-

munities. A substantial increase was shown in the period in the total importance of government — federal and state — in the economic affairs of Arizona. A lessening of the degree of importance of agriculture and a relative increase in the degree of importance of manufacturing were manifested during the period.

Diversification

Historically, Arizona's economy was long referred to in terms of the "C's" — copper, cattle, cotton, and climate. Concern was always felt because of lack of balance in the state's economic structure. However, recent studies at the Bureau of Business and Public Research at the University of Arizona show decided gains toward greater diversification as measured by the extent to which the pattern of employment in this state follows that of the country as a whole. Projections for the decade of the sixties indicate an increasing pattern of diversification.

The percentage distribution of employment in mid-1959, as shown by the Arizona State Employment Service, indicates that of Arizona's total non-agricultural employment of over 299,000 persons, manufacturing occupied 45,300, or 15.1 percent, as against 24.6 percent for the United States as a whole; a total of 16,000, or 5.3 percent, in mining as against 1 percent for the entire country; and 62,800, or 20.9 percent, employed by the government compared to 12.4 percent for the United States as a whole. The distribution pattern, showing employment in transportation and public utilities, in trade, in service lines, and in finance, insurance, and real estate in Arizona, is much the same as the pattern for the



— Phoenix Chamber of Commerce

Skyline view of Phoenix, one of America's fastest-growing cities

country as a whole, as shown in the statistical tables in Appendix A.

The total nonagricultural employment increased from 155,200 in 1950 to 299,900 in 1959. The increase in manufacturing was from 15,700 to 45,300, and the increase in percentage of manufacturing employment in relation to total nonagricultural employment in Arizona was from 10.2 to 15.1 percent.

Although agriculture as a category has been increasing absolutely in recent years, it showed a decline both absolutely in 1959 — due to a poor cotton crop — and relatively, while manufacturing increased both absolutely and relatively. Furthermore, the range of discrepancy between Arizona and the United States as a whole in each of these categories is diminishing.

Distribution geographically of total employment numbering 237,000 in 1950 showed 46 percent of the total number in Maricopa County and 18 percent in Pima County, with the remaining twelve counties having 36 percent of the total employment. In 1959, total employment numbering 400,600 showed 52 percent in Maricopa County, and 20 percent in Pima County, while the figure for the remaining twelve counties had fallen to 28 percent.

Population

Preliminary figures from the 1960 census place Arizona's population at 1,288,433, an increase of over 71 percent since 1950, and nearly 200 percent

since 1940 when the population was 499,261. Maricopa County showed an increase in its percentage of the total population from 37 percent in 1940 to 44 percent in 1950 and 51 percent in 1960. Pima County's share of the total population increased from 15 percent in 1940 to 19 percent in 1950 to over 20 percent in 1960. The population of the twelve remaining counties was 48 percent of the total of the state in 1940 and 32 percent in 1950, while in 1960 it fell to 29 percent. This means, of course, that considerably more than half of the state's population is concentrated in the Phoenix and Tucson metropolitan areas which have a combined population in excess of 900,000 people. The economic significance of these two areas for market and production centers is obvious.

The Valley National Bank has compiled figures to show that only 291,000 people — fewer than 40 percent of the total — in Arizona in 1950 were natives of the state. This, together with other evidence shows clearly that people have come and will continue to come to Arizona in response to opportunity.

Climate

The accelerated influx of people into Arizona can be attributed to: increase in manufacturing, wider recognition and understanding of the advantages offered by Arizona to health and recreation seekers, the increase in federal government services and in-

stallations. Undoubtedly improvements in the technology of air conditioning have contributed enormously to the rapid growth of population. The consequent availability of labor supply has induced industrial establishments to locate in the state.

Climate has affected economic development in Arizona in many ways. The southern and western parts of the state are in the arid climatic classification, with a mean annual rainfall from less than five inches to about ten inches. Crop production on the basis of natural rainfall is virtually impossible, and except in certain fortunate areas, the ranges provide only for rather sparse cattle population. Most of the remainder of the state falls in the semi-arid classification with annual precipitation between ten and twenty inches. Rainfall in both regions is very irregularly distributed and may be divided into summer rains (July and August) and winter rains (November to March). Data show May and June to be the driest months and July and August the wettest. Precipitation in winter is gentle and lasts for several days, in contrast to summer rains which are torrential, irregular, and marked by localized storms. At very high elevations annual precipitation ranges up to 28 or 30 inches. Long-term normal rainfall for Yuma is 3.6 inches and for McNary 23 inches. The range in altitude is from 125 feet above sea level in Yuma to more than 12,000 feet above sea level near Flagstaff. The mean maximum temperature at Flagstaff is almost the same as the mean minimum temperature for the year at Yuma.

Tree-ring and climatic studies show no real evidence of any substantial climatic changes in the Southwest during the last 2,000 years. Extremely high and low temperatures have been recorded, but fortunately the disadvantages of the unfavorably extreme temperatures during a relatively small part of the year in any locality are more than offset by the very favorable temperatures during the longer period of the year. While all portions of the state are not equally attractive for living at all times of the year, every locality is attractive during a considerable portion of the year. No other state can report as high a percentage of sunshine which is more than 80 percent of the possible sunshine in many localities. Southern Arizona has a climate comparable to that of part of the Mediterranean area. The hot summers are made more moderate by July and August rains. Winter crops grow with relatively small consumption of water. High consumption of water goes with high temperatures, low humidity, and intense solar

radiation in summer. Arizona has twelve of the twenty-two main types of vegetation that have been distinguished in the United States and ten of the major categories of world vegetation. The advantages of favorable climatic conditions are well known: the long growing seasons making possible, for example, six to eight alfalfa crops in Yuma County during a single year and three or four agricultural crops in other areas; a low rate of absenteeism by Arizona workers in all lines of production; the absence of inconvenience due to rains, smoke, fogs, and storms; the low cost of fuel, clothing and housing in the central and southern parts of Arizona.

The importance of climate as an attraction for tourists in Arizona requires little elaboration. Climate as an amenity to an increasing number of people has not received the treatment that it deserves. Measurement of the potentialities of exploiting climate is difficult, but it is believed that the surface is almost unscratched in the building of the tourist industry as a major item in the economic development of Arizona. Tourist expenditures in Arizona were estimated at \$280 million in 1959. Major effort on the part of various public and private groups should result in enhancing the amount of income derived from tourist sources.

Agriculture

The story of agriculture in Arizona can be told in terms of rapid growth and increase in high-level production, increase in acreage under irrigation, and, most importantly perhaps, increase in the eagerness of the alert farmer-rancher citizenry for scientific knowledge, and in the adaptability of this citizenry to rapid changes in price structure and other changes that occur.

Less than 2 percent of Arizona's 72 million acres is devoted to agricultural crops. In 1959 about 1,260,000 acres were devoted to crops, an increase of more than 100,000 acres over 1957. Although acreage has been decreased in recent years by reduction in cotton allotments, this decrease has been balanced by new acreage going into production, largely in Yuma, Cochise, and western Maricopa counties.

Since scarcely any successful farming operation can be carried on in Arizona except by irrigation, water supply is the primary limiting factor in expansion of agricultural production. Irrigated acreage doubled between 1900 and 1916; doubled again between 1916 and 1946; and between 1946 and



Modern cattle feeding pens near Phoenix

1959 almost doubled again. Again, decrease in some deep-lift pumping areas was offset by the development of the new irrigable lands thereby minimizing a decline in irrigated acreage, despite water problems.

More than 6 million acre-feet of water are being used annually in crop production. About 4 million acre-feet of this supply are pumped and some 2 million acre-feet represent diversion from streams and storage dams. The rapid rate of increase of pumpage during recent years and the consequent reduction in the rate of recharge of the underground water supply, have resulted in substantial reduction in subsurface water tables. The U. S. Geological Survey reports a decline in this water level in the more heavily pumped areas of as much as eighty to 100 feet from 1955 to 1960. Parenthetically it must be emphasized that although there is a shortage of water supply on the basis of the prevailing arts of acquisition and utilization of water for agricultural purposes, there is no shortage of water for domestic, commercial, and industrial uses in most areas of Arizona. Also to be emphasized very vigorously is the vast differential between the amount of water necessary for agricultural purposes and the amount necessary for these other purposes. Mr. R. J. McMullin, of the Salt River Valley Water Users' Association, recently pointed out that as population increases, it is conceivable that less water will be required for agricultural purposes. For example, currently of the total of 239,000 irrigable acres in the Salt River Project, 194,000 are devoted to agriculture and 45,000 — a much higher figure than previously — to residential, commercial, and industrial uses. But with further urbanization of this area, acreage now devoted to agriculture will be withdrawn for other uses with consequent reduction in the draft on subsurface water supply.

In 1900, about 200,000 acres were under irriga-

tion largely from water diverted from streams in the state. Roosevelt Dam was completed in 1911, and other reservoir storage systems were developed during the decades between 1910 and 1930. Today, underground pumpage, as noted above, provides about two-thirds of the water supply. In a given seven- or eight-year period, the pumping lift has more than doubled, in some areas being as great as 300 to 500 feet, according to a recent Geological Survey report. The amount of water pumped in 1953 was twice that pumped in 1946, but since 1953-54 has levelled off considerably.

Arizona agriculture contributed \$404 million of the state's total income of \$2,450 million from all sources in 1959, or about 16 percent of the total. This represents an increase of about seven-fold since 1940 and a decrease of about \$17 million from the peak year, 1948. Nevertheless 1959 ranks as the third highest year of agricultural income in Arizona, with 1952 second with \$410 million. Rises and falls in these totals were influenced by the acceleration of cotton production in Arizona in the late forties and early fifties, then by the reduction of prices of agricultural products and the federal program of reduced cotton acreage, and also by the rise in price of certain other agricultural products in more recent years.

The agricultural income of \$404 million in 1959 is represented by \$137 million from animal products and \$267 million from crops, these consisting largely of cotton, alfalfa, small grains, and grain sorghums, citrus, and vegetables. Cotton was grown in 1959 on 29 percent of the acres planted and yielded 53 percent of the total income from crop production, as against 60 percent in 1955. This drop can be explained by lowered prices on cotton, as well as the rise in price for other agricultural products.

Phenomenal results have been achieved in cotton

production, measured by the increase of the rate of production per acre and the total amount produced. Until 1958, Arizona ranked first for seven years among cotton states in production per acre. With the infestation of pink bollworm in some areas, yields declined slightly and California ranked first in 1958-59, with Arizona second. In 1959, Arizona's average yield was just under two bales, or 924 pounds per acre as compared with the national average of 465 pounds per acre. Arizona currently ranks sixth among states in total amount of cotton produced. New varieties of cotton developed by the University of Arizona's Agricultural Experiment Station, especially adapted to Arizona's cultural and climatic conditions and superior in texture and spinning qualities, account in large part for the greatly increased income from cotton. Other factors contributing significantly to these results are the improvement in efficient use of land and water, better control of insects, and more effective use of fertilizers.

Production income from cattle on ranges, covering about 85 percent of Arizona's vast area, has shown marked increase during the last twenty-five years. This growth, of course, has been subject to wide variations year by year because of price changes and the vicissitudes that go with ranching in arid and semi-arid regions. The actual number of range cattle, 800,000 head in 1959, has increased slightly over what it was twenty-five years ago. The increase from the \$16 million cash income in 1940, and \$74 million in 1954, to \$97 million in 1959, aside from the change in the value of the dollar, is accounted for largely by improvements in feeding, breeding, and range management practices.

Enough has been said to emphasize the amazing agricultural expansion in recent years in Arizona. Rapid growth in the future will depend on many factors, but primarily on availability of an increased water supply. Apart from the Colorado River as a source, which even with the possibility of supplemental water provision can do little more than help the state maintain its present acreage and production levels, further increase is dependent upon success of scientific research directed toward (a) increase in water supply, and (b) better utilization and conservation practices with reference to the existing water supply.

Increase in water supply will depend largely upon research into the possibility of increasing the available runoff of watersheds into rivers and reservoirs, reduction in loss from canals and irrigated areas,

and more remote eventualities, such as economically feasible conversion of saline water. Discovery and development of new varieties of plants, with higher yields from given amounts of water, may also help to preserve the existing supply.

Mining

The mining industry prior to World War II was the most important Arizona industry, measured as a source of revenue. However, today there is little difference in income yielded from each of the major sources: mining, agriculture, and manufacturing. Measured by comparative numbers employed and by relative income derived, mining is more important for Arizona than it is for the country as a whole. The total number employed in mining increased from 11,000 in 1950 to over 16,000 in 1959. This represents 5.3 percent of the total non-agricultural employment in Arizona. The corresponding percentage employed in mining in the United States as a whole in 1959 was 1 percent.

Copper is the leading product of mining and accounted for 81 percent of Arizona's total mining income in 1958. Since 1910, Arizona has been the leading state in production of copper, and presently accounts for 50 percent of the total production of this commodity in the entire United States. Arizona has stood first annually since 1944 in combined value of nonferrous metals, including lead, zinc, gold, and silver. In percentage of gain in copper mining, Arizona has led all other states during the fifteen-year period since World War II.

Factors accounting for the rate of high production of copper include improvements in technological methods of ore production and beneficiation, the high demand by industry and government, and the discovery and opening of new mines. The grade of copper ore mined has become lower and lower since the date that Arizona assumed its leadership in production. Therefore, to remain competitive, the mining industry of Arizona has had to develop new and more efficient methods of mining and recovery from the ore.

In the last few years much expansion has taken place in copper mining in Arizona. For example, the Ray Mines Division of Kennecott Copper Corporation has erected recently at Hayden a \$5 million plant for the recovery of copper from copper oxide and copper silicate minerals which previously were being lost in the mill tailings. In addition, this same company has sponsored the development of the new



Mining continues to be one of Arizona's principal industries

town of Kearny in order to make modern housing facilities available to its employees. The San Manuel Copper Corporation also has constructed a new townsite — San Manuel — where its mill and smelter are located. In the Tucson area, copper is becoming an increasingly important part of the economy, and mines and mills are located at the Silverbell and East Mission properties of the American Smelting and Refining Company, at the Pima property of the Pima Mining Company, at the Esperanza property of Duval Potash and Sulphur Company, and at the Banner and San Xavier operations of the Banner Mining Company.

The rate of consumption of copper and other minerals helps to accent the fact that the well-being of the mining industry and the country as a whole requires that new ore be discovered as rapidly as ore is mined and processed. There are those who believe that new ore deposits will be more and more difficult to locate from geological indications. Considerable time and money have been expended during the past

fifteen years in developing geophysical methods which have been successful in locating petroleum in many countries. As applied to minerals, geophysical methods can be used to yield a metalliferous deposit or indications of subsurface geological structure. Such indications must be followed by drilling operations which may or may not confirm the geophysical interpretation. Already, at least three major ore bodies have been discovered in the state by geophysical methods and it appears entirely probable that other mineral deposits will be found. In fact, Arizona has led all states in the Union in the discovery of new copper ore bodies since the close of World War II, and it is likely that this trend of successful exploration will continue in the future.

In addition to copper, Arizona possesses also appreciable deposits of other metallic as well as non-metallic minerals, including, among other commodities, such substances as gold, silver, lead, zinc, molybdenum, sand, gravel, gem stones, asbestos, gypsum, cement, and coal. During recent years,

uranium ore has been mined in northern and central Arizona. Likewise, explorations for petroleum and natural gas in Arizona continue to attract favorable attention. In Apache County near the Utah boundary, commercial production of gas and oil has begun, following the discovery by drilling of these fuels, and a pipeline from the Four Corners area to the Los Angeles region is under construction.

Manufacturing

As already indicated, manufacturing, measured by amount of employment offered and income derived, is contending with agriculture and mining for a leading position in the Arizona economic picture. In 1945, only 11,000 persons were employed in manufacturing and income derived from manufacturing was only \$105 million. In 1950, 14,800 were employed and \$142 million derived. By mid-1959, the number employed was over 45,000 and the income estimated for 1959 was \$550 million.

The absolute size of Arizona's manufacturing industry is not impressive as compared with that of any one of a great many eastern industrial cities. The surprising thing is that manufacturing got started at all in Arizona. Many states would seem to offer more locational advantages: local markets, easy access to raw materials and to national markets, more adequate labor supply, more attractive freight rate structure, and more local capital for investment purposes. There are, however, good reasons for the manufacturing development in Arizona. In the first place, some of the conventional reasons given for location of industry do not have special application to the kinds of manufacturing found in Arizona. Furthermore, government activity really accounts for the impetus given to manufacturing in this state. Plants occupied by some of the major manufacturing companies today were built originally during the war period by companies having contracts with the federal government. The policy of dispersion of industry played a part earlier and still plays a part in this development.

It is important to note that some industries were attracted to Arizona simply because important executive officers had visited Arizona, liked the climate, and saw the opportunities. Then proximity to military installations, such as the Army's Electronic Proving Grounds at Fort Huachuca in southern Arizona, has accounted for the location of a number of relatively small manufacturing operations in this part of the state. Specific inducements have been offered

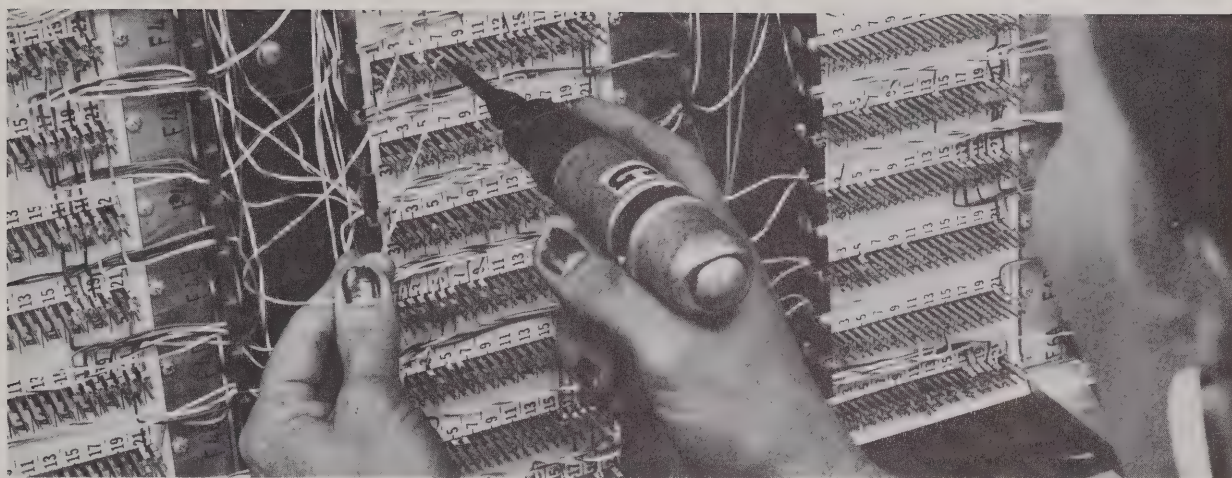
in a number of instances: repeal of inventory taxes on manufacturers, special system for assessing machinery and equipment, and elimination of sales taxes on sales made to the federal government.

Some items in the cost of living index are favorable in Arizona: low fuel bills for domestic heating in southern and central Arizona, low total cost of clothing, and, to some extent, low incidence of sickness with consequent small medical bills. Rentals and food costs offer no advantages over many other localities about the country, but they offer no special disadvantages. The low rate of absenteeism in industry has already been mentioned.

Arizona industry for the most part produces output of small bulk. Most of the demand is by government, and price is frequently not an important consideration. The cost of freight transportation is not high relatively for most Arizona manufacturers. The fact that people like to live in Arizona cannot be over-emphasized as a factor that brings people to this state. The Chambers of Commerce of many Arizona cities have on file several thousand letters from people wanting to come to Arizona provided employment can be found. This reservoir of labor supply represents, for the most part, professional and highly-skilled or technical workers. Arizona has always attracted and will continue to attract more people than can find jobs in the state. Heavy industry will not come to Arizona because of disadvantages that have already been implied. Electronics manufacturing, production of planes or plane parts, machine tools, spinning and weaving industries, processing of building materials, pulp paper mills and wood products industries, manufacture of foodstuff, and clothing manufacturing are types of industry already attracted to Arizona, and additional opportunities in these fields would seem to warrant further investigation by companies seeking favorable locations.

Role of Government and the Tax Structure

The prominent part of government — state and federal — in the economic affairs of Arizona has already been noted. It takes many forms: management of the public domain, the operation of the defense installations, employment of labor services, tax collection. Federally-owned land in Arizona amounts to more than 30 million acres, or almost 45 percent of the total land area. Additionally, the federal government holds in trust for Indians more than 19 million acres, or almost 27 percent of the total area. The state of Arizona owns almost 10



— Phoenix Chamber of Commerce

Electronics plants account for much of the state's rapid industrial growth

million acres, nearly 14 percent of the total area. Less than 15 percent, or about 11 million acres, is privately owned.

There are those, of course, who object strongly to government ownership of such a large portion of the land area of Arizona. They contend that productivity of the land represented by the public domain would be increased under private management. On the other hand, there are those who take the position that federal government land-management policies and practices bring about more productive results in some directions than if either state or private ownership and management were substituted for federal ownership and management.

Government employment in mid-1959 numbered 62,800 of a total nonagricultural employment figure of 299,900, or 21 percent of the total. This represents a considerable increase over the corresponding figure for 1955. Employment by the federal government totaled 19,800, and by the state and local governments, 43,000. The U.S. Defense Department leads in federal employment with almost 39 percent of the total of federal employees, and the three other top federal divisions, in order, are the Department of the Interior, the Post Office Department, and the Veterans Administration. These four divisions of federal service account for about 80 percent of the total federal employment in Arizona. Federal civilian payrolls in Arizona currently are running at the rate of \$100 million per year, while state and local government payrolls will amount to around \$200 million in 1959.

Finally, the government as tax collector plays

an enormously important role in the economic life of Arizona. For the fiscal year 1958-59 total taxes collected amounted to \$479.2 million, of which about 55 percent represented federal levies and 45 percent state and local levies. Of the total state and local collections the property tax yielded 49.4 percent, the general sales tax 19.5 percent, the income tax 6.7 percent, the motor fuel tax 10.2 percent, and excise taxes, license fees and permits 9.1 percent.

Arizona's economy and its future are, of course, related to the economic health of the country as a whole. That Arizona's economic life is intimately bound up with national defense is incontrovertible. Its agriculture is vitally affected by national agricultural policy, although in many respects agriculture would be better off in Arizona under a more laissez-faire federal agricultural policy. The mining industry is vitally affected by demands of national defense. The manufacturing development of recent times is substantially influenced by federal military and defense policies. This does not imply, however, that the future of manufacturing in Arizona is precarious. Huge defense expenditures are probably here to stay, and community leaders throughout the state are alert to the necessity of broadening the economy to lessen Arizona's reliance on defense spending.

Given a healthy national economic climate, Arizona's economy will continue to expand and prosper. Arizona's natural advantages can be used to minimize the disadvantages which have been mentioned, and the increasing desire of people to live in a warm, sunny climate will continue to attract workers whose skills will, in turn, attract new industry.

..... *manufacturing and commerce*

ARIZONA'S GROWTH IN MANUFACTURING MAY BE considered, for the most part, as a normal resultant accompanying its rapid population expansion. In 1900, when Arizona Territory had only 122,931 residents, there were at least 2,700 employees in manufacturing establishments. By 1930, when the state's population had grown to 435,523, there were somewhat less than 9,800 employees in this field. And in 1959, with a state population estimated at 1,266,000, there were over 45,000 persons (April estimate) earning wages and salaries in manufacturing. Thus, in 1959, about one of every 26 Arizonans was a manufacturing employee, compared to one out of 44 in 1930 and one out of 46 in 1900.

Manufacturing is now offering employment to over 45,000 individuals in Arizona, and ranks third among the various segments of the state's economy on the basis of numbers employed, being exceeded only by wholesale and retail trade and by government. In 1949, the estimated value of Arizona-manufactured products was \$129 million; in 1958, the value leaped 280 percent to \$490 million.

Prior to 1950, mining and agriculture were in a class by themselves as the two top income-producing industries of Arizona, but since that year increases in manufacturing have brought this industry into this same top class. Today, it's the big three: mining, agriculture, and manufacturing.

Considering only nonagricultural business activities, Table I presents important figures for the period 1950-58 bearing upon the relative importance of manufacturing in Arizona and in the nation.

It is apparent that during the period 1950-58 the difference between the percentage of nonagricul-

tural employees engaged in manufacturing in Arizona and the percentage in the nation as a whole was narrowed from 23.3 to 15.9, and thus that Arizona made a highly significant gain in this regard. Certainly the state has been moving rapidly in the direction of a more industrialized economy.

It is apparent also, however, that in 1958 Arizona was still well below the national average in the relative importance of manufacturing among non-agricultural business activities, a situation which is characteristic of the Mountain States as a group.

In the case of Arizona, the deficit as compared with the national percentage of employees in non-agricultural employment can be accounted for largely by three other categories in which its percentages are considerably higher than the national percentages. These, as shown in Table II, are mining, contract construction, and government.

The large number of employees in mining is easily explained: after all, Arizona has ranked first among the states in copper mining for a long time. Contract construction is high for one primary reason, that Arizona is growing, and consequently building, at a faster pace than most of the other states.

The high degree of government employment is not so readily understandable, since only by combining wholesale and retail trade can an employment category be created to exceed it. (Agriculture, not shown in the table, employs about 45,000 in Arizona.) The most recent figures available at the time of writing suggest that, in Arizona, there were in late 1959 about 20,000 federal employees and nearly 46,000 state and local salary earners (including over 25,000 in the educational system). Particular note

TABLE I
Employees in Manufacturing
As a Percentage of Total Nonagricultural Employment
United States and Arizona, 1930-1958 (in thousands)

	United States ^a			Arizona ^b		
	Total	Mfg.	Mfg. as % of Total	Total	Mfg.	Mfg. as % of Total
1930	29,143	9,401	32.3	N.A.	N.A.	N.A.
1940	32,058	10,780	33.6	N.A.	N.A.	N.A.
1950	44,738	14,967	33.5	155.2	15.8	10.2
1958	50,543	15,468	30.6	276.8	40.6	14.7

N.A. Not Available

Sources: a. Business Statistics, 1959 Edition (A supplement to the *Survey of Current Business*), U.S. Dept. of Commerce, Office of Business Economics. P. 60. (Annual averages).

b. 1950-58: *Arizona Basic Economic Data*, 1959, Employment Security Commission of Arizona, Phoenix, Pp. 51, 60. (April figures).

TABLE II
Distribution of Nonagricultural Wage and Salaried Employees
by Category of Activity, United States and Arizona, April 1959

	United States ^a		Arizona ^b	
Category	Number	Percent	Number	Percent
Manufacturing	16,034,000	31.2	45,300	15.1
Mining	694,000	1.3	16,000	5.3
Contract Construction	2,662,000	5.2	28,800	9.6
Transportation, Communication, Public Utilities	3,879,000	7.5	23,100	7.7
Wholesale & Retail Trade	11,136,000	21.7	71,200	23.7
Finance, Insurance, Real Estate	2,403,000	4.7	12,600	4.2
Service Trades	6,511,000	12.6	40,100	13.4
Government	8,111,000	15.8	62,800	21.0
Total	51,430,000	100.0	299,900	100.0

Sources: a. *Monthly Labor Review*, U.S. Dept. of Labor, Bureau of Labor Statistics, October, 1959. Pp. 1157-1160.

b. *Arizona Basic Economic Data*, 1959, Employment Security Commission of Arizona, Phoenix, p. 51.

should be taken that members of the armed forces are not included in the 20,000 federal employees cited; these are all civilians. This high level of federal employment is generally found throughout the Mountain States, and can only be accounted for by federal operations such as the Bureau of Reclamation, the Forest Service, the National Park Service, the Bureau of Mines, and other governmental agencies which are less active elsewhere.

It was noted in the preceding paragraph that members of the armed forces are specifically excluded from the figures shown in Table II. Although

such information is not readily available to the general public, it is nevertheless quite clear that military activity plays an important part in Arizona's economic life. For example, the city of Sierra Vista owes its very existence to its presence at the gates of Fort Huachuca, the Army's Electronic Proving Ground, which is now commencing construction of a unique multi-million dollar Electronic Environmental Test Facility across almost the entire breadth of southern Arizona. Yuma, which will benefit from being the western terminus of this E.E.T.F., already counts the U. S. Army Test Station and a Marine Corps air

TABLE III
Summary of Arizona Retail Trade in 1958^a

County	Establishments ^b	Sales ^c	Payroll ^d	Employees ^e
Apache	154	\$ 13,395	\$ 1,068	508
Cochise	565	52,774	4,916	1,880
Coconino	397	55,437	6,693	2,145
Gila	290	24,864	2,404	868
Graham	173	15,097	1,402	533
Greenlee	106	8,959	969	404
Maricopa	5,417	733,257	80,363	29,500
Mohave	157	10,721	1,230	437
Navajo	329	31,791	3,151	1,514
Pima	2,175	289,125	32,394	11,552
Pinal	605	55,453	5,162	2,132
Santa Cruz	134	27,336	2,387	1,114
Yavapai	415	30,150	2,800	1,168
Yuma	546	64,016	6,700	2,354
State Total	11,463	1,412,375	151,639	56,109

- a. Final data from 1958 Census of Business
b. Total, including 3,556 in Arizona without payrolls
c. Total all establishments, in thousands
d. Thousands
e. Total paid employees, work week ended nearest November 15

TABLE IV
Paid Employees in Retail Trade in Arizona Counties,
and Percentage Changes 1929-1958

County	No. of Employees 1929	No. of Employees 1939	Pct. Change 1929-39	No. of Employees 1948	Pct. Change 1939-48	No. of Employees 1958	Pct. Change 1948-58
Apache	154	192	24.7	267	39.1	508	90.3
Cochise	1,264	1,157	-8.5	1,406	21.5	1,880	33.7
Coconino	673	661	-1.8	1,323	100.2	2,145	62.1
Gila	984	607	-38.3	844	39.0	868	2.8
Graham	176	274	55.7	479	74.8	533	11.3
Greenlee	194	179	-7.7	376	110.1	404	7.4
Maricopa	5,815	7,051	21.3	15,351	117.7	29,500	92.2
Mohave	154	342	122.1	469	37.1	437	-6.8
Navajo	450	437	-2.9	821	87.8	1,514	84.4
Pima	2,171	3,193	47.1	7,225	126.3	11,552	59.9
Pinal	358	507	41.6	1,136	124.1	2,132	87.7
Santa Cruz	562	450	-19.3	659	46.4	1,114	69.0
Yavapai	901	880	-2.3	1,221	38.8	1,168	-4.4
Yuma	589	647	9.8	1,315	103.2	2,354	79.0
State Total	16,536	16,577	*	32,892	98.4	56,109	70.6

*Negligible change (less than one-half of one per cent)

Source: The Censuses of Business of 1929, 1939, 1948 and 1958, Bureau of the Census, United States, Department of Commerce.

facility as part of its economic base. In contrast to the lack of availability of state totals for the number and payroll of the armed forces, figures are available showing the net value of military procurement ac-

tions for supplies, services, and construction in Arizona. In fiscal year 1957, this figure amounted to \$175,217,000, rising to \$189,314,000 in fiscal year 1958, jumping to \$238,989,000 in 1959.

TABLE V
Retail Trade by Categories, Arizona 1958

Category	Sales	Paid Employees
Lumber, Building, Hardware	\$ 105,976,000	3,018
General Merchandise Stores	133,156,000	6,727
Food Stores	330,563,000	7,366
Automotive Dealers	262,217,000	6,009
Gasoline Service Stations	131,118,000	4,388
Apparel and Accessory Stores	77,750,000	4,020
Furniture and Appliance Stores	77,950,000	2,937
Eating and Drinking Places	119,969,000	13,739
Drug Stores	58,007,000	3,322
Other (Liquor, Farm, Jewelry, etc.)	95,700,000	3,855
Nonstore Retailers	19,969,000	728
Total	\$1,412,375,000	56,109

Source: 1958 Census of Business, Bureau of the Census, U.S. Department of Commerce

Commerce

Table II also shows the importance of commerce to Arizona's economy, the proportion of employees in wholesale and retail trade being not markedly different from the nation as a whole. In nearly all respects, commerce has tended to follow the state's population increases rather more closely than has manufacturing.

In measuring commercial activity, either actual amounts or percentage changes, or a combination of both, are appropriate. But if dollar values are used, either by themselves or in the form of percentages or index numbers, then some method must be accepted to relate them to a particular, arbitrarily chosen, time period. Since there is some question about the "best" base year to choose, plus the fact that very little study has been made of the dollar's purchasing power in Arizona at any one time — much less over a period of years — dollar values are used sparingly and as an indicator of general magnitude only, and other statistics are used to illustrate the growth and dispersion of trade.

At least two satisfactory series for retail trade in the state are available: number of establishments and number of employees. There have been minor long-term changes in the size of the average store, but it is believed these are not sufficiently serious to affect the value of this series as an indicator.

Although Table III gives a good picture of the state's current retail trade patterns, Table IV was prepared to illustrate the development of these patterns using numbers of paid retail employees only, and showing the percentage of changes in the number of employees between Business Censuses.

It is clear from Table IV that, although Arizona retail activity has been increasing rapidly for about twenty years, this has by no means been uniform throughout the state, but in certain instances has shown marked variations in a single county.

Perhaps the most extreme case of divergence is that of Mohave County, which showed an astounding 122.1 percent growth between 1929 and 1939 (while the state, on the average, changed practically none), and then fell to a 6.8 percent loss from 1948 to 1958, the largest percentage decrease among Arizona's fourteen counties. Mohave County, of course, has a relatively small population, and minor absolute changes result in wider percentage fluctuations than would be the case in larger economies.

In Maricopa County, which the Bureau of the Census defines as the Phoenix Standard Metropolitan Statistical Area, and which currently comprises about half of Arizona's population, growth in each decade has considerably exceeded that for the entire state. Pima County, the Tucson Standard Metropolitan Statistical Area, did even better than this performance except in the most recent decade, when its retail trade growth fell below not only Phoenix but also that of the state as a whole.

For the period 1948–1958, it is seen that nine of Arizona's fourteen counties exhibited moderate to high rates of growth. These counties, ranked in order with the fastest-growing first, are Maricopa (92.2), Apache (90.3), Pinal (87.7), Navajo (84.4), Santa Cruz (69.0), Coconino (62.1), Pima (59.9), and Cochise (33.7). The other five counties showed either a low rate of increase or an actual loss; they are Graham (11.3), Greenlee (7.4), Gila (–2.8),

TABLE VI
Retail and Wholesale Trade in Arizona Counties, 1958

County	Retail	Wholesale	Wholesale Trade as a Percent of Retail Trade
Apache	\$ 13,395,000	\$ 2,986,000	22.3
Cochise	52,774,000	15,484,000	29.3
Coconino	55,437,000	18,035,000	32.5
Gila	24,864,000	6,721,000	27.0
Graham	15,097,000	5,331,000	35.3
Greenlee	8,959,000	1,090,000	12.2
Maricopa	733,257,000	905,586,000	123.5
Mohave	10,721,000	3,315,000	30.9
Navajo	31,791,000	10,767,000	33.9
Pima	289,125,000	161,095,000	55.7
Pinal	55,453,000	16,995,000	30.6
Santa Cruz	27,336,000	31,071,000	113.7
Yavapai	27,336,000	15,927,000	52.8
Yuma	64,016,000	38,133,000	59.6
State Total	\$1,412,375,000	\$1,232,536,000	87.3

Source: 1958 Census of Business, Bureau of the Census, U.S. Department of Commerce (wholesale trade data preliminary).

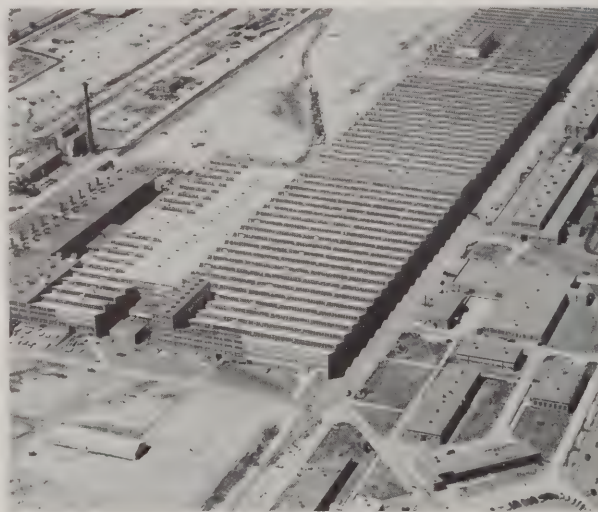
Yavapai (-4.4), and Mohave (-6.8). The method used here of illustrating change in terms of employment is certainly not so impressive as the more usual method of illustrating it in terms of dollar volumes. Inasmuch as we live today in an inflationary economy, the approach on the basis of employment does have the virtue of presenting a picture more nearly in harmony with reality.

Table V needs little comment, except to say that retail trade, in its distribution by categories, is not substantially different from other states in the nation.

Another category of Arizona's commercial activity which must be considered, even though briefly, is wholesaling. Here, business tends to be more concentrated in a few major centers.

When wholesale trade is expressed as a percentage of retail trade in the manner of Table VI some important facts emerge. The most important among these is that two counties, in this comparison, stand head and shoulders above the rest, and the surprising thing here is that Pima County, the second largest in population, is not one of them.

In terms of this ratio the second ranking county is Santa Cruz, in spite of the fact that its retail sales—almost all of which are made in Nogales—are vastly swelled by sales to tourists, both American and Mexican. It is, of course, as a center of wholesale trading with the West Coast of Mexico that Nogales has achieved distinction for Santa Cruz County.



— Phoenix Chamber of Commerce

Reynolds Metal Company — Phoenix

There really is only one wholesale point of the first rank in Arizona, and that is Phoenix. There are, however, four other cities that we shall class here as important, although subsidiary, these being Tucson (Pima County), Yuma (Yuma County), Nogales (Santa Cruz County), and Flagstaff (Coconino County). This selection is admittedly rather arbitrary, and actually is not of very great significance, since, in 1958, Phoenix sold 73.5 percent, or practically three-fourths, of Arizona's wholesale goods.

..... *mining*

ARIZONA HAS BEEN, UNTIL VERY RECENTLY, THE youngest state in the Union, but its economic progress and development have been phenomenal. Many of these advances can be attributed directly to the wealth of mineral resources that abound in the state, and to the great mining enterprises which have been established to make the deposits effective in the economy of Arizona and the United States.

Today Arizona ranks fourteenth in the value of production of all minerals and rock materials. This is, in itself, an excellent position, but a fact of greater significance is that Arizona leads all other states in the value of nonferrous metals produced. That is, those states that outranked Arizona in total value of mineral production achieved their position largely because of the production of iron ore, or mineral fuels such as coal, petroleum, and natural gas.

Arizona produces appreciable quantities of over thirty-five types of minerals and is especially famous for its tremendous tonnages of copper and other nonferrous metals. Among the states of the Union, including Alaska and Hawaii, Arizona ranked first during 1957, in copper production, being over twice as great in this respect as its nearest competitor state, Utah. It ranked fourth in production of silver, fifth in gold, and seventh in both lead and zinc. Arizona supplied one-half of the total copper output of the United States in 1958, thus leading all other states, something it has done consistently since 1910.

In the period from 1860 to 1958, inclusive, Arizona's mines produced over seven billion dollars of mineral wealth. Since 1874, when the first specific records were kept, the state has yielded more than 32 billion pounds of copper. This is a truly remark-

able total which now is being added to at the rate of approximately one billion pounds a year. In Arizona mining, copper is king.

The copper production is supplemented by the values of many other mineral commodities. To secure these, the removal of tremendous quantities of mineral-bearing rocks is required. A mineral deposit in the ground has, as such, no value to man. It is only when a deposit is brought into production that real benefit is derived. This benefit is achieved by the building of a mining enterprise which, in every case today, requires the diligent application of economic analysis, capital investment, and labor. These activities in Arizona have broadened the tangible value of the state's resources, and the mining industries of Arizona are magnificent developments, lending much to the economic and cultural advancement.

Modern man always has been prone to explore first for the glittering metals of comparatively high unit value. Thus, the history of the exploitation of mineral resources of any region is that metallic mineral deposits are sought and worked before those of the nonmetallic (industrial mineral) type. The development of industrial or nonmetallic mineral bodies ordinarily awaits the settlement of a region and the growth of local industries. Since the coming of the White man to what is now Arizona, the situation has paralleled this common pattern. However, the mining pursued by the prehistoric inhabitants was mainly for nonmetallic commodities.

Aboriginal Mining

The original Indians were agrarian peoples, who were engaged primarily in agriculture with little or

no knowledge of, or apparent interest in, the use of metals, either for commercial purposes or for ornamentation. However, these early inhabitants learned, in the course of time, of the benefits of such resources as salt, coal, building stone and pottery clay, and, also, of the applicability of particular nonmetallic substances for making mauls, knives, spear points, pigments, and ornamental beads. There is clear-cut archaeological evidence that mining enterprises, crude as judged by present standards but nonetheless effective and important to such prehistoric peoples, existed by 1000 A.D. Therefore, the aboriginal mining period is considered to extend from 1000 A.D. to about the middle of the sixteenth century.

John T. Hack has written of a coal mining industry which was well-developed by the prehistoric Hopi Indians in the Jeddito Valley along the southern edge of Black Mesa, north of the present town of Holbrook, Arizona. He has noted that the early Hopi people apparently had discovered the use of coal as a means of securing heat at about the same time a similar discovery was made by the early inhabitants of England. By the beginning of the thirteenth century, the Hopi were exploiting the Jeddito Valley deposits to a marked degree.

The main coal seam, which is comprised of rather "bony" (impure) coal ranging from lignite to sub-bituminous, is a flat-lying bed in rocks of Cretaceous age. It is covered by varying amounts of younger rocks. The ancient mining method which was used is very similar to that of modern strip-mining. It was a procedure of removing the overburden and excavating the exposed coal. The waste (overburden and "bone") was piled to the rear of the working area. The result was to leave a tract stripped of coal and overlying rock, and piled high with heaps of waste material. When the overburden was too thick to remove by the crude excavating and hauling devices, the mine area usually was abandoned. However, in at least one locality, there is evidence that underground mining by a primitive "longwall" method was pursued successfully.

The coal mines were operated through a period of about 300 years, and the total amount of coal extracted probably exceeded 100,000 tons. This is an amazing amount considering the primitive tools and equipment then available. Coal was used for domestic heating and cooking and for the firing of pottery vessels, which was a companion industry.

The well-known archaeologist, Earl Morris, in his monograph "An Aboriginal Salt Mine at Camp

Verde, Arizona" (Anthropological Papers of the American Museum of Natural History, Vol. XXX, Part III, New York, 1928) has described an aboriginal salt mine near Camp Verde in central Arizona. Here, in comparatively unconsolidated manner, there are intercalated, essentially flat-lying layers of sands, gravels, clays, and various salt compounds. The early peoples worked these deposits, seeking supplies of sodium chloride, or common table salt.

In his study cited above, Morris described the methods of salt mining of the aborigines. When the natives found a promising salt stratum they followed where it led, often unsystematically. They used no timbers or pillars in such salt mining. These early miners, working between 1200 and 1400 A.D., apparently developed several mine levels and at least one subsurface shaft and they removed several thousand cubic yards of rock material. There can be no question that the ancient inhabitants of the region were engaged in a salt mining enterprise of important industrial nature. Indeed, it probably was the first of Arizona's mining industries.

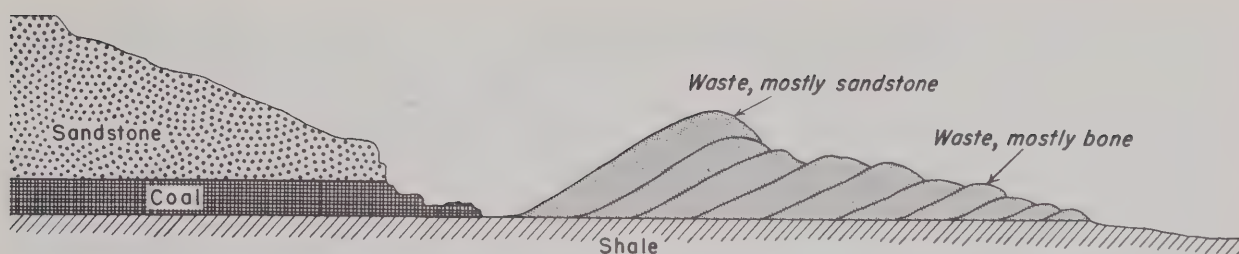
The aborigines also mined turquoise for making jewelry and similar artifacts. Prehistoric turquoise mines have been reported on the east side of Canyon Creek just above its confluence with the Salt River, on Turquoise Mountain in Cochise County, in the Mineral Park area of Mohave County, and in other locations throughout the state.

It is evident that the early aboriginal people of Arizona, though following primarily an agricultural way of life, also practiced noteworthy mining industries as a part of their total existence. These prehistoric activities may be considered as harbingers of the great, present-day mining enterprises of Arizona.

The Spanish Period

The Spanish period extends essentially from the middle of the sixteenth century to the time of the Gadsden Purchase in 1853, when the region of Arizona was opened to occupancy by citizens of the United States. It is distinct from the earlier period for several reasons, but chiefly because it marked the beginning of the White man's exploitation of Arizona's mineral resources.

Soon after the conquest of Mexico by Cortez, the Spanish explorers entered Arizona in quest of the gold, silver, and other mineral riches that had been reported to them as fabulous in quantity and richness. Fray Marcos de Niza in 1539 led the first expedition. His glowing, though false reports, re-



Ideal section of a typical Hopi strip mine — after John T. Hack

sulted in the expedition led by Francisco Vásquez de Coronado in 1540 in search of the legendary Seven Cities of Cibola. These expeditions were doomed to failure because the Indians had not developed metal commodities, and, as these substances were not important in their cultures, they had never accumulated them. Thus, there was no wealth of the precious metals which the conquistadors could plunder.

It was not until 1582, when Antonio de Espejo prospected near the headwaters of the Verde River that actual mining of silver ore was done. Although historical records do not indicate what quantities of ore were produced by Espejo's venture, it is an important occasion, if for no other reason than that it marks the beginning of metal mining in Arizona.

Juan de Oñate is reported to have found rich silver ore during an expedition in 1604 along the Santa Maria and Bill Williams rivers. However, it was not until 1705, when Father Kino did some prospecting for silver near the present Mexican border, that further active mining was done. Frank P. Knight, in his *Mining in Arizona* (Department of Mineral Resources, State of Arizona, January, 1958) argues that the Planches de Plata silver deposits near Nogales stimulated mining beginning about 1736. When the Spanish settled Tucson, they mined gold and silver, and it is reported that gold placers existed at Quitojoa in 1774.

According to G. M. Butler ("Arizona and Its Heritage," University of Arizona *Bulletin*, Vol. VII, No. 3 [April 1, 1936]), it is impossible to estimate closely how much mineral wealth was removed while the Spaniards and Mexicans controlled the region of Arizona, but it is certain that there was appreciable mining before the Declaration of Independence by the United States. Butler writes: "There is a tradition that \$60,000 worth of silver utensils once decorated the altar of San Xavier Mission and that this metal was mined in the Santa Rita Mountains. The padres

at Tumacácori Mission certainly directed silver mining operations in those mountains, and the Spaniards are known also to have operated in the Arivaca district and in the Baboquivari, Patagonia, Tucson, and Catalina mountains. There is some evidence that they or the Mexicans mined as far north as the Sierita Mountains north of Tucson."

After the Mexican Revolution of 1822, the Mexican military garrisons which protected the Spanish-Mexican prospectors in the Arizona region were withdrawn, and the area was subjected to increased depredations by Apaches and outlaws. Mining waned thereafter until about 1849, when other military forces concerned with the United States-Mexican Boundary Commission were established in the Territory.

Early American Prospecting

Several essentially contemporaneous events occurred in the mid-1800's to contribute to the renewal of vigorous prospecting and to the development of mining activities. For example, the protection afforded by the establishment of new military posts in the area, the Gadsden Purchase of 1853, which opened the Territory to citizens of the United States, and the great gold rush to California that led many people into the region of Arizona — all served to spur the development of mining and prospecting.

This period, which was characterized by the work of intrepid pioneers, extended from the mid-1800's to the turn of the 20th century. These people were developers of the country, bent on wresting their fortunes from the ground by the vigor of their own labors. They were fortune seekers, it is true, but they were willing to devote much individual effort and to endure much hardship in their quest for mineral wealth. Except for the Civil War years, prospecting and mining activities continued unabated throughout the period. In fact, the influence of these enterprises showed a really phenomenal growth.



— Frank P. Knight

An early-day prospector in Arizona

Soon after the Gadsden Purchase, United States citizens came in increasing numbers to prospect for ore in Arizona. The large copper deposit at Ajo, now known as the New Cornelia Mine, was located and the Arizona Mining Company — the first incorporated mining company in Arizona — was organized to work it.

The placer gold deposits along the lower Colorado River were important sources of the metal in the early period. The Gila City placers — some twenty miles east of Yuma — were discovered in 1858, and a series of rich placers was located along the Colorado north of Yuma between 1861 and 1864. At about the same time, gold placers were discovered on Lynx Creek and at Weaver and Rich Hill in Yavapai County. The rich Vulture Mine, found in 1863, caused the settlement of nearby Wickenburg. In the Patagonia Mountains the large

lead-silver deposit now called the Mowry Mine had been worked by Spaniards, but was relocated by a group of American soldiers in 1858. It is claimed that this mine produced a considerable portion of the lead for bullets used by Confederate soldiers. Forty miles southwest of Tucson, the great Cerro Colorado Mine had yielded \$100,000 worth of silver by 1860.

With the outbreak of the Civil War and the withdrawal of federal troops from the Territory, the Apaches once more took over and most of the mines were closed. During this period the few active mining camps were around Prescott, Wickenburg, and Mineral Park, near Oatman in the Cerbat Mountains, and north of Yuma. All were gold and silver mines except the Planet Copper Mine near the Bill Williams River.

The end of the Civil War and the reestablish-



— Frank P. Knight

Copper mining in Arizona about 1900

ment of military posts caused the renewal of prospecting activity with increased vigor, although the menace of Apache attacks continued until 1882. In the decade of the seventies, many of Arizona's famous copper deposits were located, including those at Globe, Bisbee, Morenci, and Jerome, as well as the Silver Bell and Twin Buttes ore bodies near Tucson.

Silver discoveries were also continuing at the same time. In 1876, the silver deposits north of Globe, including the McMillan Mine, and the profitable Silver King north of Superior were found. In 1878 Ed Schieffelin discovered ore at Tombstone and one year later the Bonanza silver deposit there was located. For several years silver production at Tombstone spread that city's fame around the world until the flooding of the mines made the extraction of ore prohibitively expensive.

With the completion of the transcontinental railroads, the exhaustion of the richer silver deposits, and the lowered price of silver, copper began to

come into its own. By 1888, copper production in Arizona was worth over \$5,000,000 a year, or more than the value of all the other metals produced. Copper production gradually increased until, by 1910, it was worth \$37,800,000. In that year, Arizona became the leading copper-producing state in the union, a position which it has continued to hold down to the present time.

Modern-Day Mining

The advent of the twentieth century marked another turn in the history of the mining industry of Arizona. By 1900, the importance of copper as a source of mineral wealth had become pronounced, and it was further advanced soon thereafter by at least two extremely salient factors. These were: (1) the development of large-scale mining procedures which were adaptable to the exploitation of comparatively low-grade mineral deposits; (2) the discovery and perfection of "flotation" as a process for the profitable beneficiation of sulphide-bearing ores.

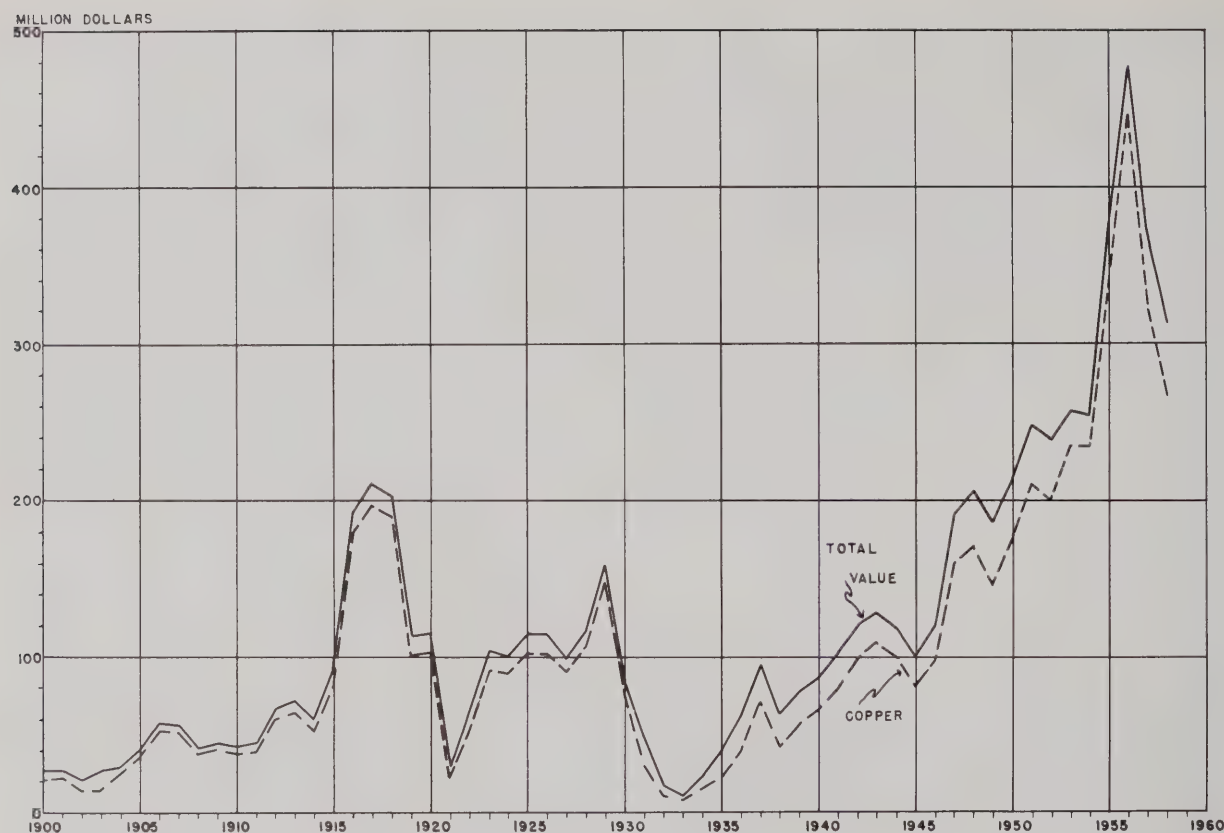


Fig. 1. Value of copper and total value of mineral production in Arizona, 1900–1958

These factors, together with the growth which continued to prevail in the production of gold, silver, lead, and zinc in Arizona, and with the vigorous economic and scientific developments of the past sixty years, all have contributed to Arizona's outstanding stature as a mineral-producing state.

As shown in Figure 1, much of the total value of mineral wealth supplied by Arizona since the turn of the present century has been derived from copper. The production of uranium ores also has become particularly noteworthy with the economic demands that have ensued for supplies of nuclear energy. However, it should be realized that the economic importance of nonmetallic minerals continues to increase each year as the population of Arizona expands — with the resultant local development of new industries. For example, the production of "common" sand and gravel now ranks second in value of all minerals annually secured in Arizona, amounting to over 12 million tons valued at more than \$9,500,000.

Table I presents the varieties and values of

mineral production in Arizona for 1958. It demonstrates that of the total value of minerals produced, 89 percent was furnished by metallic mineral substances, of which copper, alone, accounted for more than 81 percent. The nonmetallic mineral commodities, including asbestos, cement, clays, coal, gem stones, mica, feldspar, fluospar, gypsum, lime, pumice, sand and gravel, and stone supplied 9 percent of the total.

COPPER. Six counties, Pima, Pinal, Cochise, Greenlee, Gila, and Yavapai annually yield about 99 percent of Arizona's copper output. Of these, the first three account for approximately 62 percent of the total, although the largest single copper mine in the state is situated in Greenlee County. Table II shows the major copper mines operating in Arizona during 1958. It is evident that the majority of these modern mines are operated by open-pit mining procedures where comparatively low-grade ores are worked by large-scale production methods. These activities require much ingenuity and engineering skill and would not have been economically possible prior to

TABLE I
Varieties and Values of Mineral Production in Arizona in 1958

Type of Commodity	Quantity	Values
Beryllium Concentrates	18 tons	\$ 10,000
Clays (exclusive of bentonite)	119,000 tons	179,000
Coal	8,000 tons	54,000
Copper (metallic)	485,839 tons	255,551,000
Gem stones	—	86,000
Gold	142,979 ounces	5,004,000
Lead (metallic)	11,890 tons	2,782,000
Lime	126 tons	1,817,000
Manganese ore (35% or more Mn)	62,279 tons	5,220,000
Manganiferous ore (5 — 35% Mn)	1,455 tons	32,000
Mercury	53 flasks (76#)	12,000
Mica	1,717 tons	25,000
Molybdenum	2,320,000 pounds	2,827,000
Pumice	401,000 tons	1,025,000
Sand and Gravel	12,208,000 tons	9,526,000
Silver (metallic)	4,685,000 ounces	4,240,000
Stone	1,528,000 tons	2,731,000
Uranium ore	257,756 tons	7,049,000
Zinc (metallic)	28,532 tons	5,821,000
		11,734,000
	Total ^a	\$314,520,000

a. Total has been adjusted to eliminate duplication in the value of raw materials used in manufacturing cement and lime.

TABLE II
Major Copper Producing Mines in Arizona in 1958

Mine	Operated by	County	Type of Operation	Ore Mined (tons)
Morenci	Phelps Dodge Corp.	Greenlee	Open-pit	4,311,334
San Manuel	San Manuel Copper Corp.	Pinal	Underground	13,039,187
New Cornelia	Phelps Dodge Corp.	Pima	Open-pit	11,486,300
Inspiration	Inspiration Consol. Copper Corp.	Gila	Open-pit	7,711,440
Ray Pit	Kennecott Copper Corp.	Pinal	Open-pit	4,621,091
Lavender Pit	Phelps Dodge Corp.	Cochise	Open-pit	4,027,522
Copper Cities	Miami Copper Company	Gila	Open-pit	2,768,390
Silver Bell	Amer. Smelting and Refin. Co.	Pima	Open-pit	2,748,600
Miami	Miami Copper Company	Gila	Underground	1,870,865
Bagdad	Bagdad Copper Corporation	Yavapai	Open-pit	1,663,614
Pima	Pima Mining Company	Pima	Open-pit	1,098,742
Copper Queen	Phelps Dodge Corporation	Cochise	Underground	4,99,257
Magma	Magma Copper Company	Pinal	Underground	391,084

N. B. 1. The Miami Mine underground production of ore was discontinued in 1959, although several thousand pounds of copper continue to be recovered each month by precipitation from copper-rich mine waters.

2. Production from the Esperanza open-pit mine of Duval Potash and Sulphur Company, in Pima County was established during 1959. It is estimated that approximately 4,500,000 tons of ore will be produced annually.

the invention of large-scale excavating and hauling machinery, improved drilling and blasting techniques, and the development of flotation and other modern recovery methods. It is not to be inferred, of course, that all Arizona mineral occurrences are of low-grade character, but it is a fact that many of the great mining enterprises of the state have been

established and maintained only by the application of outstanding engineering skills. This is true of the major underground mines as well as of those mines being worked by open-cut methods, where in order to secure each ton of the ore-bearing material it is quite commonly necessary to remove also about two tons of non-productive material and waste rock.



—Phelps Dodge Corp.

A modern-day copper mine, mill and smelter

TABLE III
Production of Gold and Silver in Arizona during 1958

County	Mines Producing		Material Sold or Treated (Short Tons)	Gold (Lode and Placer)		Silver (Lode and Placer)	
	Lode	Placer		Troy Ounces	Value	Troy Ounces	Value
Cochise	11	—	4,528,720	44,710	\$1,654,850	863,152	\$781,186
Gila	14	—	9,248,093	1,429	50,015	139,069	125,864
Graham	2	—	24	1	35	97	88
Greenlee	1	—	13,040,057	8,071	282,485	639,302	578,601
Maricopa	2	—	105	42	1,470	123	111
Mohave	7	—	388	17	595	5,522	4,998
Navajo	—	—	(uranium by-product)	2	70	758	686
Pima	20	2	11,757,647	29,798	1,042,930	951,275	860,952
Pinal	12	—	16,141,811	30,607	1,071,245	974,138	881,644
Santa Cruz	10	—	27,857	58	2,030	121,625	110,077
Yavapai	15	1	2,027,528	28,137	984,795	989,279	895,347
Yuma	6	1	589	107	3,745	240	217

Because of discoveries of new deposits by scientific prospecting practices and the extension of other earlier-known ore bodies, together with the perfecting of improved mining and metallurgical

methods, which tend to make low-grade mineral occurrences exploitable at a profit, the known copper reserves of Arizona today are at least twice as great as they were at the beginning of the twentieth



— Frank P. Knight

Lead mining in Arizona around 1900 (left) and same mine as preceding picture, 50 years later

century. This is remarkable considering the large amounts of copper that have been mined in the state in the last sixty years.

GOLD AND SILVER. The position of Arizona as an important supplier of gold and silver has been maintained for many years. Since 1860, more than twelve million ounces of gold valued at almost \$319,000,000, and 351 million ounces of silver, valued at \$270,000,000 have been produced. The value of these commodities in 1958 was, respectively, \$5,004,265 and \$4,239,781. Value by counties is shown in Table III.

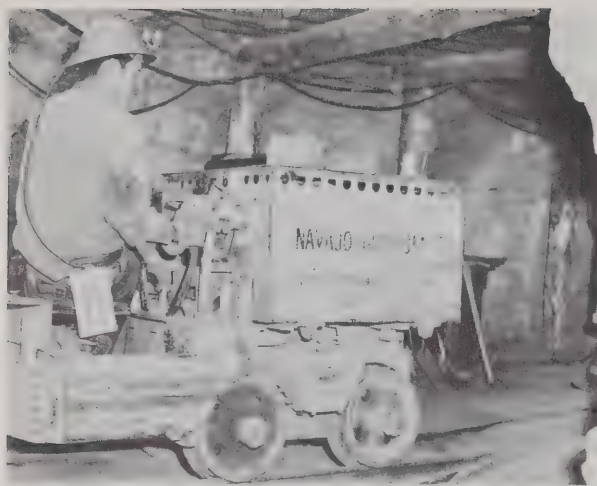
In the early days a large proportion of these metals was obtained from mining operations developed primarily for the production of precious metals. This led to the establishment of several famous mines such as the Vulture near Wickenburg, the Tom Reed and United Eastern near Oatman, the Silver King near Superior, and the various mines to work the bonanza silver deposits at Tombstone. Today, however, the majority of the gold and silver is secured as a by-product of copper, lead, and zinc mining enterprises. For example, three mines, the Copper Queen and New Cornelia branches of the Phelps Dodge Corporation, and the Iron King property of the Shattuck Denn Mining Corporation, furnished 71 percent of the gold output in 1958. The next four producers who supplied almost all of the remaining 29 percent of the gold were the San Manuel Corporation, Magma Copper Company, Morenci Mine of the Phelps Dodge Corporation, and the Ray Mines Division of Kennecott Copper Corporation. The Iron King, the Copper Queen and Morenci properties, the Magma Mine, and the New

Cornelia operations, listed in order of output, were the five leading producers of silver, supplying 71 percent of the state's total in 1958.

LEAD AND ZINC. Lead and zinc have played major roles over the years in the development of the mining industry of Arizona, but, of the various mineral commodities produced in the state, they seem to have been subject to more economic fluctuations than any other materials. This is especially true at the present time when cheap foreign production leads to the dumping of these substances on the domestic market, to the detriment of local operations. From a peak of 104,226 tons of lead-zinc in 1949, the output has declined to only 40,422 tons in 1958, and most of this has come from less than six of the larger lead-zinc properties which were able to operate, it seems, only because of their income from copper, gold, and silver by-products.

The Iron King Mine of the Shattuck Denn Mining Corporation in Yavapai County supplied two-thirds of the lead secured in Arizona during 1958. The San Xavier Mine in Pima County and the Glove and Flux Mines in Santa Cruz County produced most of the balance of the lead output. Seventy percent of the zinc came from the Iron King property, and most of the remainder came from the San Xavier, Atlas, Flux, and Old Dick Mines.

URANIUM AND VANADIUM. Although there was no uranium mining of consequence in Arizona prior to the demand for sources of material to yield atomic energy, the uranium industry now has become of such importance as to rank comparatively high in the state's mining economy. Production of uranium-bearing ores has been obtained primarily



— Tad Nichols

Navajos hauling uranium ore — by electric power (left) and by burro power

from sedimentary rock occurrences in Apache, Coconino, and Navajo counties. During 1958, the principal suppliers were Rare Metals Corporation, Kerr-McGee Oil Industries, Inc., Vanadium Corporation of America, Western Gold and Uranium, Inc., Gibraltar Minerals Company, and Industrial Uranium Company. A total of eighty-six mines were recorded as working in 1958, producing 257,756 tons having an F. O. B. mine value of \$7,048,973.

Uranium ores containing significant quantities of vanadium, principally from Apache County, were processed for recovery of vanadium. The quantity recovered in 1958 was notably greater than in 1957.

MISCELLANEOUS METALS.

Manganese. The United States Geological Survey estimates that about 200 million tons of low-grade manganese ore occur in Arizona. Utilization of this ore in the future is predicted since the United States is now largely dependent upon foreign sources.

Present production of manganese ore and concentrate is dependent on a marketing program administered by the General Services Administration of the federal government. Under this program in 1958, manganese ore was secured from eleven counties, the largest amounts coming from Yuma, Maricopa, Mohave, Gila, and Pima counties.

Mercury. Mercury production in Arizona has never been of major consequence, and has shown a pronounced tendency to fluctuate in response to prices fixed by world marketing conditions. Production fell from 100 flasks in 1956 to twenty-eight flasks in 1957, rising to fifty-three flasks the following year. Four mines were the source of the

material, two in Gila County and two in Maricopa. Two-thirds of the 1958 total came from the processing of ore obtained from the Gold Creek Mine in Gila County.

Molybdenum. The molybdenum produced in Arizona is secured as an important by-product material of several of the major copper mining enterprises. During 1959, molybdenite was recovered as an accessory material from copper concentrates made by copper mining operations conducted at Miami, Morenci, Silver Bell, San Manuel, Bagdad, Inspiration, Pima, and Esperanza properties. A total of 2,320,000 pounds valued at almost three million dollars was obtained in 1958.

Beryllium. During 1958 the production of beryllium ore came chiefly from three operations in Yavapai County where the beryl (a beryllium, aluminum silicate) was recovered by mining pegmatite deposits.

Iron. The possible potential of iron in Arizona continues to attract interest. In 1958, a small company constructed a magnetic-separation pilot plant at the Omega placer iron deposit some 30 miles north of Tucson. The company produced 500 tons of concentrate containing an average 66 percent iron but none was shipped.

Pyrite. Pyrite (FeS_2) which is used chiefly in the manufacture of sulphuric acid, now is being obtained as a by-product material in the concentrating of copper ores by the Magma Copper Company and the Kennecott Copper Corporation.

Tungsten. Tungsten has been produced sporadically in Arizona but, as its market price is fixed through control of the federal government, it has



— Arizona Portland Cement Co.

Quarry and plant of Arizona Portland Cement Company at Rillito

TABLE IV
Production of Sand and Gravel
in Arizona in 1958

County	Quantity (tons)	Value
Apache	120,000	\$ 103,000
Cochise	773,000	606,000
Coconino	1,025,000	901,000
Gila	724,000	621,000
Graham	3,000	4,000
Greenlee	2,000	2,000
Maricopa	5,036,000	3,870,000
Mohave	7,000	9,000
Navajo	97,000	103,000
Pima	1,965,000	1,565,000
Pinal	1,328,000	909,000
Santa Cruz	62,000	504,000
Yavapai	603,000	425,000
Yuma	395,000	279,000

been subject to the vicissitudes of failure to maintain price supports. Production in recent years has continually decreased and in 1958 none at all was produced.

SAND AND GRAVEL. The major rank of sand and gravel as mineral commodities often is not fully appreciated by people unversed in mineral affairs. This is probably because of the comparatively low-

unit value of these substances and also because of the "common" character and wide distribution. During 1958, these materials ranked second in value to copper as a source of mineral wealth in Arizona. County values are shown in Table IV. They are used chiefly in all types of building and highway construction, and their importance will continue to grow as Arizona becomes more densely populated.

ASBESTOS. Asbestos, as an industrial mineral commodity, is of some consequence in Arizona. Eighteen properties, practically all in Gila County, are listed as potential producers of chrysolite, which is a cross-fiber and slip-fiber type of asbestos. It is believed that this substance will continue to grow in economic importance in the state.

CEMENT. Cement is manufactured primarily from suitable limestone and shale rocks, and its production records show a continuing tendency to increase in Arizona as more and more construction projects are instituted in the state. During 1958, the Arizona Portland Cement Company steadily operated its quarry and three-kiln plant near Tucson, the bulk of the output being sold locally in Arizona. The American Cement Corporation began construction of a large plant at Clarkdale in Yavapai County in 1958, where suitable raw materials are located. Although the quarry and processing plant are being

designed primarily to supply three million barrels of cement for construction of the Glen Canyon Dam and related facilities, it is entirely likely that they will continue to operate after this need is fulfilled.

MISCELLANEOUS INDUSTRIAL MINERALS. The demand for various other industrial minerals has shown a continuing upward trend in Arizona during the last twenty to thirty years. This is attributed primarily to the growth of population in the state and, as a result, many small operations have sprung up to satisfy the needs of local markets. In some cases, of course, the output of certain commodities has gone to satisfy out-of-state consumers.

Clays. Common clays used in pressed-brick and adobe-brick manufacture are produced in a number of plants. The total value and quantity of this output in 1958, was, respectively, \$179,000 and 119,000 tons. Bentonite, which is a special, very fine-grained variety of clay material, was obtained in considerable quantity at an open-pit operation of the Cheto Mine near Sanders, Arizona. Its chief use is in foundries as a conditioner of molding sand and as an agent in oil refining and in oil-well drilling fluids.

Feldspar. During 1958, feldspar was mined by the Sena Mining Company in Mohave County. The crude material was ground at a mill in Kingman. It is used in glass, pottery, and enamel-ware manufacturing, and as a fluxing agent in metallurgical processes. A considerable part of the feldspar was shipped to consumers in Arkansas, California, Colorado, Louisiana, Ohio, Texas, Canada, and Mexico.

Fluorspar. Fluorspar was produced from two properties in Arizona during 1958. A small quantity of mine-run material was produced from the Snowball Mine in Maricopa County, where it was obtained by the Monolith Portland Cement Company for use in manufacturing of cement compounds. The National Fluorspar and Chemical Company produced 755 tons of fluorspar ore from the Bluebird Mine in Gila County. About half of this tonnage was of acid-grade fluorspar and was shipped to the government stockpile.

Gem Stones. Gem stones have been secured in Arizona for many years and, though the production has never been great, it has been persistent. Most of these substances are obtained by surface gleaning rather than actual mining operations. During 1958, the collecting activities were centered in Yavapai, Gila, and Navajo counties, each yielding over \$11,000 worth of materials. Copper specimens, including gem-quality chrysocolla, which is a copper silicate

mineral, were the most important in terms of value although appreciable quantities of turquoise, agate, and petrified wood were obtained also.

Gypsum. Gypsum, a calcium sulphate mineral, is used chiefly in the manufacture of plaster wallboard and lath, as a retarder in cement, and for agricultural purposes. Its production in Arizona has continually increased as industrial activities have grown in the state. Two mines — those of the Union Gypsum Company and the Arizona Gypsum Corporation — were operated in Pinal County in 1958.

Lime and Stone. Several limestone quarries, which are operated to secure lime used in treatment of copper ores and other industrial processes, have become established in Arizona. During 1958, quarries and limekilns were worked by the Paul Lime Plant, Hoopes and Company, Phelps Dodge Corporation, San Manuel Copper Corporation, and United States Lime Products Division. These operations were chiefly in Cochise, Gila, Greenlee, Pinal, and Yavapai counties.

In addition to limestone deposits worked as a source of cement and lime, there have been a number of quarries operated in Arizona to supply industrial rocks used in construction projects of various kinds. These include operations yielding granite, basalt and related volcanic rocks, marble, sandstone, and other stone substances. For example, a considerable amount of flagstone has been, and will be used for residential construction and related enterprises. In 1958, production of stone was chiefly from Pima, Cochise, and Yavapai counties.

Mica. Scrap variety mica used chiefly for roofing and paint manufacture has been obtained in Cochise and Maricopa counties. Deposits near Tombstone, and at Buckeye and Quartzite were mined in 1958.

Bat Guano. As a source of nitrogen compounds used for making oil conditioners and fertilizers, bat guano was taken in 1958 by the Randall Mills Corporation from Bat Cave situated on the north wall of the Grand Canyon. The crude material was sold to the United States Guano Corporation of Kingman, for processing and distribution.

Perlite. A rock substance used chiefly as a lightweight aggregate and insulating medium, perlite has been produced mainly from Pinal County. Production in 1958 was somewhat less than that for the previous year.

Pumice. The securing of material classified as pumice is of considerable importance in the current mineral-industry economy of Arizona. It is of vol-



— Ray Manley

Open pit copper mines at Ajo, Phelps Dodge Corporation

canic origin and consists primarily of cinder rock although some tuffa is used also. The output in tons of cinder rock (scoria) increased only slightly in 1958, compared with 1957, but the value of production gained as much as 60 percent, due to a reduction in the quantity of low-value material (used for railroad ballast) produced, and a growing demand for higher quality rock used in manufacturing lightweight building blocks. The Winona scoria deposit near Flagstaff was worked as surface quarries by the Atchison, Topeka and Santa Fe Railway Company, Harenberg Block Company, Inc., and Superlite Builders Supply Company. This made Coconino County the principal producing area in the state. San Xavier Rock Company obtained its scoria for building block from a deposit east of Douglas, the Gila Valley Cinder Company from claims near Safford,

and Arizona Precast Concrete Company from properties near Mesa.

Mineral Fuels. Although some of the first mining in Arizona was that done for coal by the prehistoric Hopi Indians, production of the mineral fuels, coal, petroleum, and natural gas has not been industrially important in recent times. However, coal has been mined in comparatively minor amounts for several years from deposits in Coconino and Navajo counties. These operations, which have been chiefly by local inhabitants for domestic use, totaled about 8,000 tons valued at \$54,000 in 1958.

Exploratory drilling for sub-surface deposits of petroleum and natural gas has been increasing steadily in recent years, amounting to more than 54,000 feet in 1958. Most of the interest has been in Apache and Mohave counties, although some

TABLE V
Minerals Produced in Arizona

<i>County</i>	<i>1957</i>	<i>1958</i>	<i>Minerals produced in 1958 in order of value</i>
Apache	\$ 3,164,474	\$ 4,324,954	Uranium ore, vanadium, clays, sand and gravel, petroleum, stone, gem stones.
Cochise	50,474,007	38,065,293	Copper, gold, silver, stone, lime, sand and gravel, manganese ore and concentrate, pumice, mica (scrap), lead, manganese ore and concentrate, uranium ore, zinc, gem stones.
Coconino	2,864,384	4,394,124	Uranium ore, sand and gravel, pumice, stone, manganese ore and concentrate, coal, gem stones.
Gila	50,935,723	43,124,640	Copper, asbestos, sand and gravel, manganese ore and concentrate, molybdenum, lime, silver, gold, stone, gem stones, fluor-spar, mercury, lead, clays.
Graham	290,079	20,402	Pumice, sand and gravel, manganese ore and concentrate, copper, stone, gem stones, silver, gold.
Greenlee	67,052,744	53,073,897	Copper, molybdenum, silver, lime, gold, stone, gem stones, sand and gravel.
Maricopa	6,206,000	5,370,894	Sand and gravel, manganese ore and concentrate, pumice, clays, stone, mica (scrap), gem stones, manganese ore and concentrate, fluor-spar, mercury, gold, copper, silver.
Mohave	911,628	950,678	Manganese ore and concentrate, stone, feldspar, manganese ore and concentrate, sand and gravel, lead, nitrogen compounds, silver, gem stones, copper, gold, zinc.
Navajo	1,495,443	2,253,126	Uranium ore, sand and gravel, coal, copper, gem stones, silver, gold.
Pima	75,739,870	66,089,879	Copper, cement, sand and gravel, zinc, gold, silver, stone, manganese ore and concentrate, lead, molybdenum, clays, gem stones, perlite.
Pinal	87,710,021	78,450,806	Copper, molybdenum, gold, sand and gravel, silver, gypsum, manganese ore and concentrate, lime, pyrites, stone, perlite, lead, manganese ore and concentrate, zinc, gem stones.
Santa Cruz	2,491,086	1,266,720	Lead, zinc, silver, manganese ore and concentrate, sand and gravel, copper, gold, manganese ore and concentrate.
Yavapai	18,254,158	16,399,450	Copper, zinc, lead, gold, silver, sand and gravel, lime, stone, molybdenum, gem stones, uranium ore, beryllium concentrate, manganese ore and concentrate, clays.
Yuma	1,117,509	1,652,166	Manganese ore and concentrate, sand and gravel, manganese ore and concentrate, copper, gem stones, gold, lead, mica (scrap), silver, zinc.
Undistributed ¹	5,230,422	288,528	
Total ²	\$372,641,000	\$314,520,000	

¹Includes some manganese ore and concentrate, sand and gravel, gem stones, and manganese ore and concentrate that cannot be assigned to specific counties.

²Total has been adjusted to eliminate duplication in the value of raw materials used in manufacturing cement and lime.

drilling explorations have been done in Cochise, Navajo, and Yuma counties. During 1958, the first commercial oil well in the history of Arizona was completed in Apache County.

Helium. The largest known reserve of helium in the free world is in Arizona. Ownership of helium properties and production of this gas have been limited to the government until recently. However, a bill passed by Congress in the summer of 1960 authorizes private ownership of helium properties and the purchase of this non-combustible gas from private firms by the government, as well as authorizing the construction of twelve private helium plants. As a result, an \$8 million plant is planned, which will process gas from the Pinto Dome field near Navajo in Apache County.

Summary

The values of minerals produced in the respective counties of Arizona during 1957 and 1958, as compiled by the United States Bureau of Mines, are given in Table V.

The diversity and quantity of mineral materials which have been and are being produced and treated in Arizona contribute to the employment of many people. As indicated in Table V, every county benefits from the exploitation of these commodities, and conservative estimates indicate that, at present, approximately 17,000 Arizonans work in the mining and processing of mineral-bearing deposits. The total annual payroll is over \$100,000,000 and, if a favorable economic climate can be maintained, it is entirely probable that these figures may be markedly expanded in the future. This is because several existing major mining enterprises have plans for expansion of current operations and, also, new metal and industrial mineral deposits will be discovered, developed, and brought into production. In addition to the direct employment of many people, the mining industries contribute to the support of allied service and manufacturing industries. For example, the annual expenditures of Arizona mining companies for supplies and power presently are estimated to be at least \$35,000,000. Frank P. Knight states in *Mining*

in Arizona (Dept. of Mineral Resources, State of Arizona, Phoenix, January 1958) that 50 percent of the value of all metals produced in Arizona has been expended in the state for wages, supplies, and state, county, city, and school taxes. The balance has gone for out-of-state purchases, refining and marketing, and as dividends to investors, many of whom are citizens of Arizona. The assessed net valuation of all mining properties in Arizona amounted to \$242,198,715 in 1959. This is essentially 16.8 percent of the total assessed valuation of property in Arizona. Its relation to the whole and to the assessments of other classes of property is shown in Figure 2.

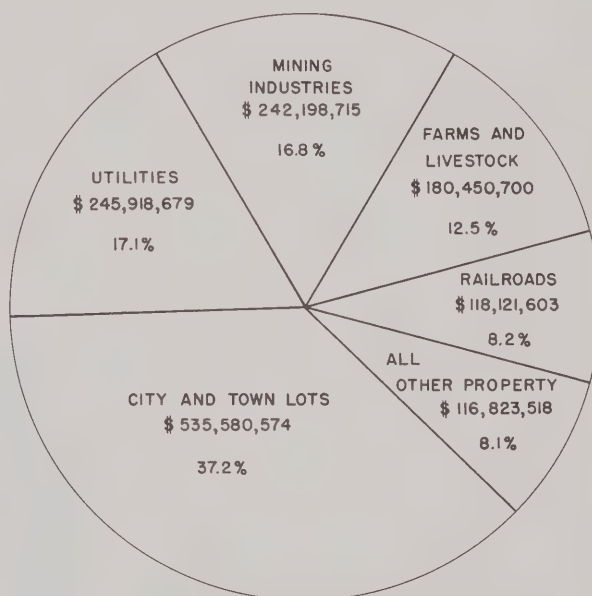


Fig. 2. Assessed valuations of properties in Arizona, 1959

It is evident that much revenue accrues annually to the state through the operations of mining enterprises, and large permanent investments of plants and equipment have been and are being made to insure economical and efficient production of such inorganic resources. The mining industry is indeed an important segment of Arizona's growing economy.

..... *farming and ranching*

THE COMBINED VALUE OF OUTPUT FROM CROPS and livestock is second only to manufacturing in the economy of Arizona. In 1959, including payments from the federal government, this value totaled \$404.4 million. In general, the number of Arizonans engaged in agricultural pursuits has declined since World War II because of urbanization, increased agricultural efficiency, and the rise of nonagricultural employment opportunities. The size of the farm as an economic unit has increased too. The expansion of the agricultural population is hindered further by the fact that only 14.78 percent of the land of Arizona is privately owned.

Agriculture

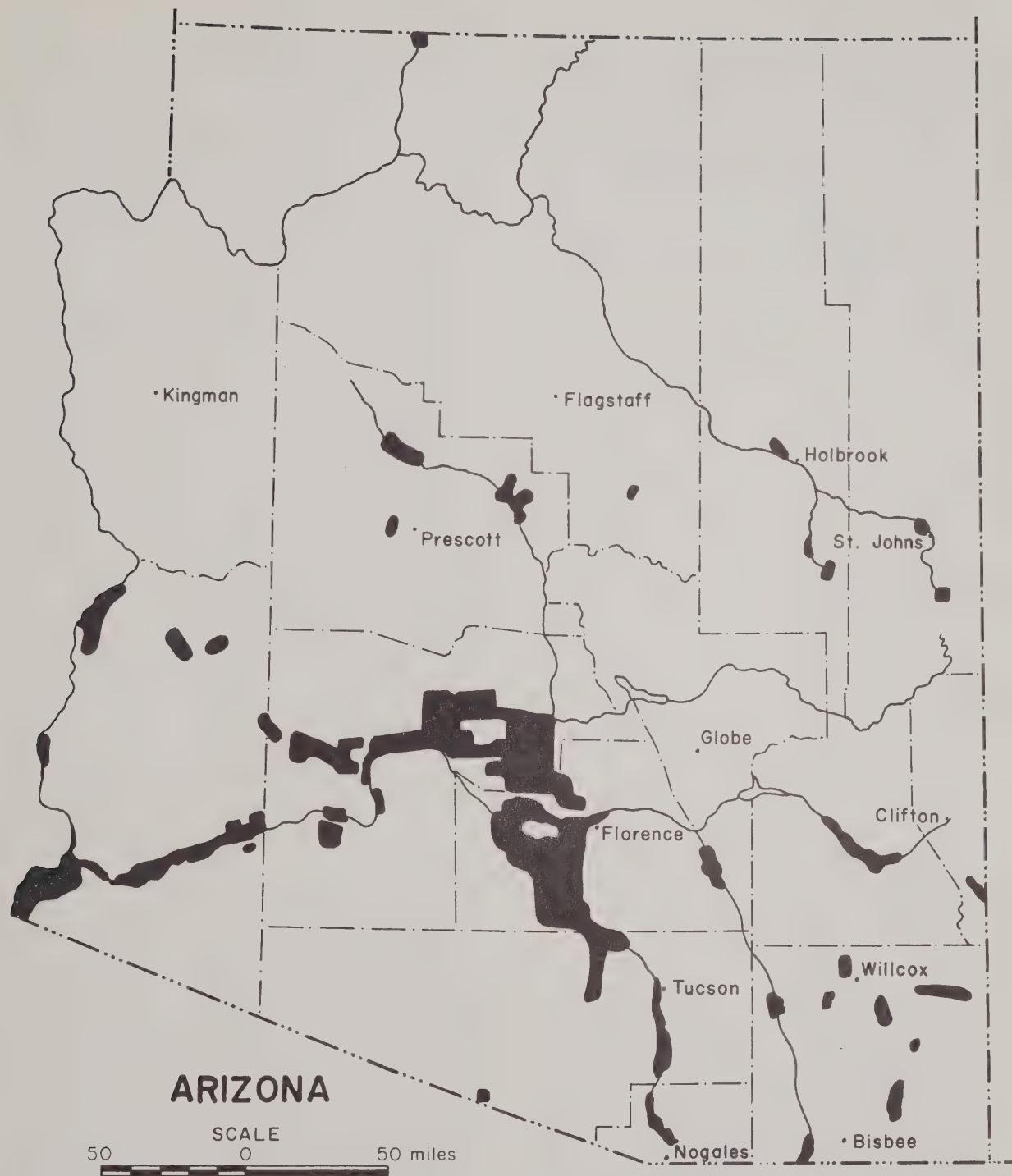
FIELD CROPS. Cotton and other field crops are the main source of Arizona's agricultural income, even though they are produced on less than 2 percent of the total area of the state. Over 90 percent of Arizona's 1,132,000 acres of field crops in 1958 were grown in the southern counties of Maricopa, Pinal, Yuma, Cochise, Pima, and Graham. The remaining field-crop acreage is found in the mountain valleys and floodplains of the northern counties of the state. With the exception of a small acreage where dry farming is practiced in northern Arizona, field crops are grown only in those areas where irrigation water is available.

Field-crop production in Arizona is characterized by large, highly mechanized, irrigated farms, which are operated by progressive farmers. High yields from soils rich in native fertility and in a climate with long growing seasons compensate for the high production costs associated with irrigation and high-value land.

Although irrigation water may be expensive, its use provides optimum moisture for crops throughout the growing season, eliminating a hazard very common in areas where crop production is directly dependent upon rainfall. The wide variety of crops grown, and the practice of double cropping in the lower valleys where winter and summer crops are grown on the same land, are also characteristic of the desert agriculture of Arizona.

In addition to keeping abreast of the most recent improvements in the traditional cultural practices of planting, cultivating, and harvesting his crops, the Arizona farmer has found it necessary to develop new skills and methods of crop production unknown twenty-five years ago. He now must know when and how to control harmful insects with an ever-increasing array of newly developed insecticides. He has learned that the fertility of his soil is not an unlimited checking account and that he must replenish the supply of certain minerals through the application of fertilizers. He has found that certain weeds can more effectively be controlled through the use of herbicides than by machine cultivation and hand-hoeing. He has cement-lined his canals and ditches and leveled his land to help prevent loss of costly water and to irrigate more effectively his crops. The increase in labor costs has been met by using machines to perform many of these tasks.

Cotton is the major crop produced in Arizona. The lower elevations of the southern part of the state are ideally suited for this crop. Cotton was grown by the American Indians for centuries before the white settlers arrived. In the past sixty years the crop has changed from a curiosity to the most im-



Areas of irrigated croplands in Arizona

portant source of Arizona's agricultural income. From a few thousand acres in 1910, the acreage has increased to nearly 400,000 acres at present; however, this is 250,000 acres less than the peak produc-

tion in 1953 before the present federal acreage control program went into effect. Lint yields of Acala-type Upland cotton average 1,000 pounds per acre and yields of 1,500 pounds are common. In ten

of the eleven years from 1948 to 1958, Arizona led the nation in cotton-lint yields per acre. In addition to its reputation for high yields, Arizona is well known for the high quality cotton its farmers grow. The release of Acala-44 in 1948 by the University of Arizona plant breeders, together with improved fertilizers, pest control, irrigation, and other cultural practices, has contributed to these fine achievements.

Although the total acreage of American-Egyptian long-staple cotton grown in Arizona is not large — 29,000 acres in 1959 — the state produced over half of the long-staple cotton grown in the United States. With better production practices and a new superior variety, long-staple lint yields have climbed from a little over half a bale per acre in the 1940's to over a bale per acre in 1958. The new variety Pima S-1, which was developed at the University of Arizona, has replaced other long-staple varieties. The development of Pima S-1 paved the way for a revival of long-staple cotton production in Arizona and the Southwest. The Supima Corporation, an organization of growers and processors of Pima S-1, was set up recently to promote the use of this type in fine fabrics and to encourage consumer buying.

Cotton is the yardstick by which other field crops are judged. There is usually a greater potential for higher profits from this crop than from other major field crops. Since federal controls reduced cotton acreages, farmers have searched in vain for a crop as profitable to grow on the acres formerly planted to cotton. When cotton cannot be grown, field crops are produced primarily for livestock feed. Alfalfa, barley, and sorghum are the main field crops used for animal feeds. The annual production of each crop is between 150,000 and 200,000 acres.

Alfalfa has been the most important forage since Territorial days. Alfalfa is grazed, green-chopped, or cut for hay. Most hay is fed locally, although some is shipped to adjacent states. A small portion of the crop is dehydrated. In Yuma and Maricopa counties, six to eight cuttings are common and yields may be as high as ten tons of hay per acre annually. The invasion of Arizona in 1955 by a new insect, the spotted alfalfa aphid, has eliminated the old standard varieties such as Hairy Peruvian and Chilean. The main alfalfa varieties now grown in southern counties are African and the new aphid-resistant Moapa. In the northern counties or at higher elevations, winter hardy varieties such as Lahontan and Buffalo are grown.

Barley is the principal small grain. Spring varie-

ties such as Arivat and California Mariout are grown as a winter crop in the southern counties.

Early fall plantings are frequently used as winter pasture for sheep and cattle. Barley may be grazed once or twice and then allowed to mature grain. Barley grain yields usually average over a ton per acre for the whole state with good fields producing over two tons. Arizona's barley yields per acre have been first or second in the nation for several years.

Sorghum, planted in early summer, often is alternated with winter plantings of barley in a double cropping program. Ratooning of sorghum, or growing two crops from one seeding, is becoming popular. Sorghum can be harvested for grain, silage, or green-chopped. Yields of over 4,000 pounds of grain or 40,000 pounds of silage per acre are common. Sorghum production is greatest in Maricopa, Pinal, and Cochise counties. The open-pollinated varieties are being replaced by hybrid sorghums which produce higher yields. Arizona's sorghum yields are the highest in the nation — evidence that this crop is well adapted to the warm climate.

Limited acreages of other crops are also grown for livestock feed. A small acreage of oats is grown as a winter crop primarily for pasturing. Corn is planted in the spring for silage or grain. Sudan grass is grown for summer pasture. Bermuda grass pastures, which are becoming more popular, are grazed during most of the year at lower elevations.

For many years the production of planting-seed for such crops as alfalfa, Bermuda grass, and sorghum has been an important agricultural industry in Arizona. Favorable growing conditions, including a minimum of damaging rains as the seed crop is matured and harvested, facilitate production of high-quality seed. Alfalfa seed production has decreased during the past decade due to lack of pollinating insects and increases in harmful insects caused by changing land use. Common Bermuda grass seed is important in Yuma County where 90 percent of the nation's crop is grown. Limited amounts of seed of several other perennial grasses are produced for range reseeding. Until the development of hybrid sorghums, large quantities of seed of open-pollinated sorghums were produced in Arizona. At the lower elevations, summer plantings of cross-pollinated hybrids do not produce satisfactory seed yields because of high temperatures and lack of wind. Production of hybrid sorghum seed is possible from summer plantings at higher elevations and at lower elevations if seed is matured in the spring or fall. Most of the

pearl millet seed used in the Southeast is grown in Arizona. One-half of the nation's sugar beet seed is produced in the Salt River Valley. Seed wheat for north central states is grown in winter plantings in Yuma County.

Production of oilseed crops, other than cotton, has varied with their price fluctuations. Flax increased after World War II but decreased to a few hundred acres when the price dropped. Castor beans are adapted to Arizona but the acreage remains small because of low prices, disease problems, and lack of high-yielding varieties suitable for mechanical harvest. Soybeans enjoyed brief popularity in the mid-1950's until an early frost in 1956 caused severe shattering losses. The production of safflower in southern Arizona is increasing since the release of Gila, a new variety resistant to phytophthora root rot, a common disease in the irrigated soils of the state.

Most growers practice some type of crop rotation. Alfalfa, cotton, sorghum, small grains, and other crops may be included. Prices, irrigation costs, soil conditions, federal controls, and other interests of the grower determine which crops are used in a rotation. Fallow periods are included to control weeds and other pests. Green manure crops, such as sesbania, papago peas, and guar, are plowed under to improve the soil.

Field crop production in northern Arizona is primarily for livestock feed, and is restricted to a few small irrigated areas. Dryland farming is decreasing; corn, alfalfa, wheat, barley, and sorghum are the main crops.

In the future, yields of all field crops in Arizona should increase as growers turn to new varieties and utilize more effective cultural practices. However, crop production acreage will be limited by water supplies. As the cities expand into rural areas, farming operations must move. Unless new sources of water are found, the acreage of field crops cannot be maintained. Production of the less profitable crops will decrease. Cotton production may be concentrated on the remaining areas. It is possible that urban expansion eventually will force this state to produce only the most profitable crops, although its climate is adapted for growing many types of field crops.

Horticulture

Horticulture includes breeding, selection, growing, protection, harvesting, processing, distribution, and selling of fruits, vegetables, flowers, and land-

scape materials. Arizona has a wealth of horticultural crops which includes lettuce, melons, citrus, grapes, roses, carrots, potatoes, pecans, peaches, and dates. Associated with the rapid urbanization developments of the Southwest, there are expanded landscaping needs for turf, trees, shrubs, and flowers. The importance of landscaping for better Arizona living is being increasingly recognized.

The diversified nature of the state's horticulture is associated with the different climatic conditions of the geographic areas. The subtropical climate of southern Arizona is attracting a very important tourist business resulting in rapidly increasing numbers of year around residents.

FRUIT GROWING INDUSTRY. The Arizona citrus industry amounts to approximately \$10 million annually. Citrus grown in Arizona includes Washington Navel oranges, Valencia oranges, Marsh grapefruit, Eureka and Lisbon lemons.

Navel oranges are grown chiefly in the Salt River Valley where appropriate climatic conditions favor this high quality citrus fruit for fresh market purposes. The successful fruit production of the variety is related to applied research findings of adequate nitrogen fertilizers and appropriate irrigation. The navel oranges are harvested and marketed during November and December for shipment throughout the United States.

The increased planting of Valencia oranges is the result of favorable markets for the fresh fruit during the spring season. Recent developments in orchard protection of Valencia oranges from low temperatures have encouraged expanded plantings. The appropriate areas for Valencia oranges are in the warmer localities in the Salt River Valley and on the Yuma Mesa. Wind machines are used very effectively, when coupled with good orchard management in winter cold protection of the young plantings and the bearing orchards. The Arizona Valencia oranges are harvested and marketed during March, April, and May before the California Valencias are available on the markets.

The lemon-growing industry of Arizona is expanding very rapidly in the Yuma area, especially in the warmer areas of the Yuma Mesa. Earlier-bearing acreages of lemons in the Salt River Valley consist largely of the Eureka variety. During the last years, the Lisbon lemon has been very popular for plantings in the Yuma area. This variety seems to have foliage and tree characteristics well-adapted to the area, with high fruit yields. Development of



Harvesting lemons on Yuma Mesa

frozen concentrated lemon juice may have an application in the Yuma area as the current acreage comes into heavy fruit bearing. The advantages of lemons grown in the Yuma area include high production with harvesting at one time resulting in lower harvest costs.

The Marsh grapefruit grown in Arizona has proved popular in various markets of the United States. The existing acreages of grapefruit are supplying good quality fruit for the fresh markets from October to June. A major portion of the grapefruit is harvested in the spring months when the quality of the fruit is best.

Other citrus varieties showing promise in Arizona are Hamlin orange, Algerian tangerine, and Minneola tangeto. The current commercial plantings of citrus in Arizona are being made by the use of virus-indexed budwood on appropriate rootstocks.

During recent years, there has been increasing interest in fresh table-grape plantings, especially in the Salt River Valley and the Yuma area. The development of the Cardinal grape by Dr. Elmer

Snyder of the U. S. Department of Agriculture – Agricultural Research Service, stimulated the increased grape plantings in the Salt River Valley. Current grape acreages in Arizona are made up largely of the Thompson Seedless and Cardinal varieties. Newest commercial table grape variety being planted in Arizona is the Exotic, a dark-blue grape which ripens soon after the Thompson Seedless. Extending the table grape harvesting season by appropriate new varieties is important in this expanding horticultural industry.

For more than half a century, 150 date varieties have been tested in Arizona, both for fruit quality and local adaptability. Due to lower atmospheric moisture conditions and more heat for fruit development, the Yuma area has proven better adapted to commercial date growing than the Salt River Valley.

The most promising variety now proved in Arizona is the Medjool. Its fruit size is large, with excellent flavor and flesh consistency. The bright amber color, coupled with attractive shape of the fruit, appeals to consumers. The variety was introduced into the United States from Morocco. Other leading commercial date varieties grown in Arizona are Khadrawy, Zahidi, and Halawi.

Commercially, peaches have been grown successfully in southeastern Arizona at elevations of 3,500 feet and above. By using early and late maturing varieties, the harvest period extends from late June until early September at these higher elevations. The peach industry is based upon the Elberta and other Elberta strains to extend the harvesting seasons. In the Salt River Valley, recent commercial ventures included establishment of peach orchards of newly developed varieties having low winter chilling requirements.

Apples in Arizona are successfully grown in mountains and mountain canyons in rather restricted areas above 4,500 feet. In these areas, red strains of Delicious, Rome Beauty, and Winesap together with Golden Delicious comprise the leading varieties. **VEGETABLE GROWING.** The vegetable industry of Arizona is important, the value of vegetable production being approximately \$75 million annually. Total vegetable acreage is approximately 100,000 acres.

Lettuce accounts for more than half the Arizona vegetable industry. The specialized areas of Arizona for lettuce growing are the Salt River Valley, where the major portion of the crop is grown, Yuma, Aguila, and Willcox. The Salt River Valley, approximately



— Arizona Photographic Associates, Inc.

Lettuce — Arizona's most important horticultural commodity — growing in the Salt River Valley

1,100 feet elevation, has two principal harvesting seasons, fall and spring. The Yuma lettuce grown at an elevation of 100 feet is harvested during the winter. Aguila, at an elevation of 2,300 feet, has two harvesting seasons, early spring and fall. In the Willcox area, at approximately 4,000 feet, fall lettuce is harvested in September and October, and the spring crop in June.

During the past ten years, there has been a revolution in the lettuce industry. Great Lakes varieties have replaced the Imperial types. With this change in varieties have come also the vacuum-cooling development, and the adaptation of fiber-board cartons to replace the wooden crates. These technological changes have made it possible to grow lettuce in various localized areas of Arizona, due to the mobility of the lettuce-cooling equipment. Use of packing sheds has become obsolete.

Through horticultural research, Arizona lettuce yields have increased 150 percent since the mid-twenties when the lettuce industry was threatened by blight. During the last few years, there has been developed low-mosaic lettuce seed which produces a better quality of lettuce.

Annual value of Arizona melons is approximately \$15 million. Cantaloupe production is increasing, especially in the Yuma area, due to decreasing production in the Imperial Valley of Cali-

fornia. The Yuma area is today the leading cantaloupe producing area for the Southwest. The popular variety is the Powdery Mildew Resistant strain, No. 45, developed by the United States Department of Agriculture. The superior cantaloupe-growing conditions in the Yuma area are related to the high-light and heat intensity and availability of water from the Colorado River for irrigation.

Potatoes are grown chiefly in the lower elevations of Maricopa County and are harvested and shipped as early potatoes during June and July. The annual value of Arizona's potato crop is nearly \$4 million.

Carrot acreage is localized in two principal districts, the Salt River Valley and the Yuma area. An important potential carrot-producing area is the lower Gila Valley, northeast of Yuma. Carrot harvesting begins in November. Most of the Yuma area shipments are made from January through April. The Phoenix area follows with heavy shipments in May and early June.

The commercial carrot variety is the large-type Emperor. The deep orange color of Arizona carrots is indicative of high vitamin A content. The handling of carrots during the last few years has changed markedly due to prepackaging. Topped carrots are frequently shipped in mesh bags and then packed in film packages at terminal markets.

There are commercially grown and shipped from



— Henk Moonen

Landscape view of the University of Arizona campus

Arizona thirty different kinds of fresh vegetables. Arizona's vegetable industry has the further diversification potential of processing with reference to freezing and canning. Through appropriate research and its applications, the development of a vegetable-processing industry may contribute to Arizona's expanding economy. The rapidly increasing population of the West is an important factor in Arizona's increasing vegetable industry.

LANDSCAPING. Home beautification and park developments emphasize the increasing importance of horticulture. Over 80 percent of Arizona's population lives in urban areas, and the percentage is increasing. This means increasing interest in home landscaping, recreational parks, improved school-ground landscaping, and other turf landscape areas for urban use.

Groups of plant materials important in the Arizona landscape picture include lawns, basic for home landscaping; palms for bold tropical effects; citrus trees as evergreens with fruit for the patio; shade trees, both evergreen and deciduous, for fruit and shade; shrubs for flowering, fruit, color, and tropical

effects; roses for all home gardens; vines and ground covers for texture and color; flowering bedding plants, bulbs and herbaceous perennials for all seasons; and cacti and succulents for desert effects.

The \$100 million annual urban horticultural industry in Arizona is rapidly expanding due to increased urbanization. The landscape attractiveness of the state is recognized as important, with increased attention to landscaping of homes, parks and parkways, school grounds, college and university campuses, athletic fields, golf courses, business and industrial sites, highways, and government grounds. The nursery industry of Arizona is represented by the Arizona Nurserymen's Association. The Southwestern Boyce Thompson Arboretum located near Superior, Arizona, has tested many trees and shrubs, bringing forth several new and unusual landscape materials. The Experimental Garden at the Arizona-Sonora Desert Museum at Tucson is co-sponsored by various organizations to test native desert plants showing promise for landscaping southern Arizona homes. The recently formed organization of Arizona Landscape Architects should help nurserymen and

attract more landscape architects to the state.

Another important phase of Arizona's urban horticulture includes the activities of many garden clubs of the state. The state's representative group is the Arizona Federation of Garden Clubs. The Arizona Gardeners' Association has recently been organized to promote better gardening practices in the state. The Arizona Shade Tree Conference has sponsored a greater appreciation and appropriate maintenance of community tree plantings. The combined interests in home landscaping, park and public grounds plantings, and the nurserymen's role in serving these interests led to the first landscape design conference in the state this year at the University of Arizona.

Lawns and turfs are basic to urban horticulture. The Sixth Annual Turf Conference was held this year at the University of Arizona, resulting in the formation of the Arizona Turf Association. In southern Arizona, the practical lawn grass, Bermuda, is especially well adapted, and by good management is green most of the year. Tifgreen, a fine-textured hybrid Bermuda, has proved superior to other fine strains for southern Arizona. Specialized uses of turf in Arizona are effectively served by other kinds of grasses and ground covers and include bent grasses, dichondra, Kentucky Bluegrass, Australian Rye, Lippia, White Dutch Clover, and Zoysias.

Insects of Economic Importance

Of the more than 20,000 kinds, or species, of insects estimated to occur in Arizona, not more than 1 percent may be regarded as significantly injurious or beneficial to man and his interests. The injurious species, although relatively few in number, are prolific and well-adapted to our climate, agriculture, and general economy and are responsible for direct and indirect losses extending into the tens of millions of dollars annually.

To protect the Arizona cotton crop from damage by insects in an average year requires the equivalent of more than thirty million pounds of insecticidal dust and expenditure of upwards of six millions dollars, including application costs. A moderate to heavy infestation of grasshoppers on ten acres of range land will consume as much vegetation as a cow. The fumigation of a typical large commercial grain elevator in central Arizona for the eradication of the khapra beetle requires an expenditure averaging about thirty thousand dollars. The commercial timber crop of northern Arizona is subject to destruction

by insects to an equivalent of hundreds of thousands of board feet annually.

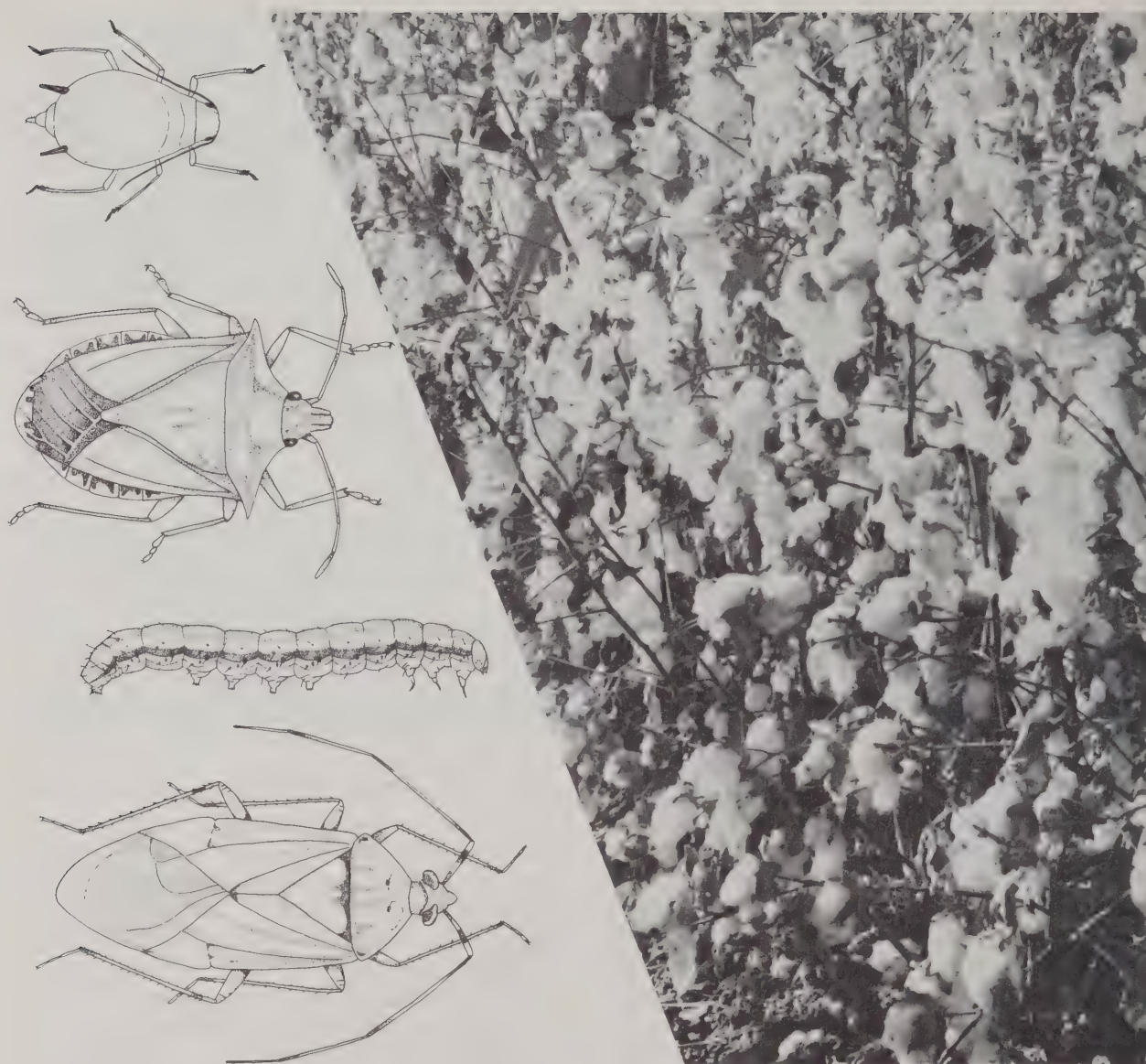
The control of termites and other pests in homes and other structures has required the services of a large and growing pest control industry, now involving at least forty firms in the Phoenix and Tucson areas alone. Large expenditures by growers are needed to control pests, and produce fruit and vegetable crops free from insect injury and yet without harmful pesticide residues. To meet these and other insect problems requires continuing, large-scale efforts by individuals, commercial organizations, and governmental agencies.

Early evidences of Arizona insects of economic importance include tunnels of wood-boring insects preserved in petrified wood from northern Arizona and representations of grasshoppers, ants, and other insects on Indian pottery. Relatively little is recorded concerning insects of economic importance until the closing years of the last century. Historical notes provided by Senator Carl Hayden, however, indicate that honey bees were first brought to Arizona from California in 1872.

In 1893 the University of Arizona Agricultural Experiment Station issued its first entomological publication, devoted largely to insects discussed in correspondence and including such present-day pests as the green June beetle, the bagworm, and the grape-leaf skeletonizer. A second bulletin, issued in 1895, discussed scale insects, including the San Jose scale, date-palm scale, and the California red scale, all of which have recently been introduced into Arizona on nursery stock.

In 1899 Professor T. D. A. Cockerell reported, in a third University of Arizona bulletin, that the Salt River Valley was "remarkably free from insect pests and especially from injurious scale insects. It would be difficult to find another locality so favored, and at the same time producing such an abundance of different crops." He attributed this freedom from insect pests to a hot, dry climate which discouraged most pests introduced from moister regions, and to the extreme isolation of the Valley from other agricultural areas. He correctly surmised that "while the present condition of affairs in the Salt River Valley is highly satisfactory, the cheerful optimism which assumes that pests cannot live there is hardly justifiable."

This relative freedom from insect pests did not long continue. Within the first dozen years of this century our present, large-scale, irrigated agricul-



Major insect pests harmful to cotton in Arizona (from top) cotton aphid, stink bug, bollworm, lygus bug

tural industry was launched with the completion of Roosevelt Dam and the Yuma Project, to be followed in later years by other projects. This new and intensively cultivated acreage served to attract local insects that had previously fed on native plants, as well as insects from other areas that entered the state through natural dispersal or through human activities. With the addition of crop irrigation to temperatures generally favorable for insect development, our southern Arizona deserts were transformed into what were aptly described by an eminent British visitor as "insect incubators." During recent

years these insects have tended to follow usually predictable patterns of activity and injury, subject to variations in weather and crop conditions and to effects of natural enemies and control practices.

Some of the insects of particular importance at the present time are mentioned below. Continuing quarantine and eradication efforts are needed to prevent or retard the introduction and establishment of additional potentially serious pests.

The leaves of cotton seedlings are weakened and distorted by the feeding of thrips. Foliage of older cotton plants is attacked by beet armyworms, cab-

bage loopers, cotton leaf perforators, salt marsh caterpillars, spider mites, and aphids. Squares and developing bolls are injured or destroyed by lygus bugs, bollworms, and stink bugs. To control these pests requires an average of three insecticide applications annually for the 400,000 acres of cotton currently grown in the state. The pink bollworm, a serious pest of bolls and developing seeds, has been introduced and apparently eradicated several times within the past thirty-five years. The largest new outbreak yet observed was discovered in 1958. It is hoped that the current eradication program will be successful. The boll weevil, the most important cotton pest of the southwestern United States, has not been found in the state although a closely related form feeds on "wild cotton" (*Thurberia*) in the lower mountainous areas of southern Arizona.

Alfalfa is attacked by a variety of insects. Hay and seed crops are injured by various species of leaf-feeding caterpillars, the spotted alfalfa aphid, and the three-cornered alfalfa hopper. Early season hay crops may also be attacked by the pea aphid, the Egyptian alfalfa weevil, and clover mites. Seed crops are also injured by lygus bugs and the clover seed chalcid. Alfalfa seed production requires pollination by adequate numbers of honey bees, which must be protected from exposure to harmful insecticides. The spotted alfalfa aphid, a native of the Old World, was first found in the United States and in Arizona in 1954 and continues to be a major alfalfa pest. Increased activity of native and introduced natural enemies, introduction of resistant varieties of alfalfa, and availability of several suitable insecticides have brought this aphid within controllable limits. Among the numerous pests of other field crops are aphids, which attack small grains, and the lesser cornstalk borer, corn earworm, and southwestern corn borer on sorghum and field corn.

Prominent among important general feeders on a number of crops are the seed-corn maggot, spider mites, aphids, thrips, flea beetles, a number of species of cutworms and armyworms, and the salt marsh caterpillar, locally known as the "woolly worm." The commercial lettuce crop is attacked by aphids and by several species of caterpillars including the corn earworm, cabbage looper, salt marsh caterpillar, yellow-striped armyworm, beet armyworm, and diamond-back moth larvae. The commercial cantaloupe crop has been attacked particularly by the beet leafhopper (a transmitter of the virus causing curly top disease), serpentine leaf miner,

spider mites, and cucumber beetles. Onions are seriously injured by the onion thrips and potatoes are attacked by a number of pests including aphids, leafhoppers, and the potato psyllid. Sweet corn is attacked by various pests including the corn earworm, lesser cornstalk borer, and southwestern corn borer.

The principal citrus pest in Arizona is the citrus thrips, which injures developing leaf growth and the rinds of fruits. Occasionally injury is caused by the cottony cushion scale and two species of spider mites. The California red scale, major pest of citrus in that state, has been brought to Arizona many times on nursery stock but has so far been successfully intercepted or later eradicated. Grapes are attacked by leafhoppers and other pests which are usually controlled readily with available insecticides.

Arizona is reported to have more species of grasshoppers than are present in any other state, although only a few species are regarded as pests. The most important injury by grasshoppers has been reported from range lands, and to an extent that fluctuates with yearly changes in weather, food plants, and the prevalence of natural enemies.

Insects in growing timber crops in northern Arizona are estimated to destroy the equivalent of hundreds of thousands of board feet of lumber annually. The principal pests of timber crops are several species of bark and engraver beetles which, together with the spruce budworm, the fall webworm, and the great basin tent caterpillars, have also injured the trees in adjacent watershed and recreational areas. These infestations have in recent years required substantial expenditures for control.

Beef and dairy cattle in Arizona are seriously attacked by cattle grubs, screwworms, horn flies, and several species of lice and ticks. Recently developed insecticides of greater safety and effectiveness have led to improved control of these pests and other benefits resulting from healthier animals. A most significant "break through" came with the recent introduction of safe and effective systematic insecticides capable of destroying developing cattle grubs within the body of the animal. Fly control is a continuing problem in dairies, corrals, feed lots, poultry houses, and in adjacent residential areas. Insecticides are now available which, when properly and regularly used, are capable of minimizing the fly problem to an extent never before possible.

A specialized and increasingly competent pest control industry has developed in Arizona to deal

with the control of termites and other insects of homes and commercial buildings. Arizona shares with most other states an assortment of common household insects such as houseflies, roaches, silverfish, clothes moths, carpet beetles, and various pests of stored food products.

Among the Arizona insects of economic importance are those beneficial to man, including the honey bee and insect predators and parasites on injurious insects. The honey bee is doubly valuable, since it serves as a commercial source of honey and as an essential pollinator of agricultural crops. Approximately 75,000 colonies of honey bees are currently maintained in Arizona. It has been estimated that flowers of desert plants (such as mesquite and cats-claw) furnish two-fifths, alfalfa one-third, and cotton one-fifth of the nectar for the annual Arizona honey crop. Honey bees are more important as pollinators than as honey producers. Production of alfalfa seed, cantaloupes, watermelons, vegetable seeds, and tangerines is largely dependent on honey bees for pollination. Predatory and parasitic insects may contribute materially to the control of certain insect pests and, under favorable conditions, may delay or reduce the need for insecticide treatments.

A most important "break through" in the history of insect control came with the wholesale introduction of new synthetic organic insecticides, starting with DDT in 1942 and continuing to the present. This world-wide development has had an enormous impact in Arizona, where it has contributed to our present high production levels of high quality crops and to the positive and improved control of most of the pests discussed above. More than 95 percent of the insecticides now used in Arizona have become generally available only since the end of World War II, including such commonly recommended synthetic compounds as DDT, benzene hexachloride, chlor-dane, aldrin, dieldrin, endrin, toxaphene, parathion, malathion, demeton, and many others.

Although the net effect of these new insecticides has been overwhelmingly on the positive side, they have created new problems, some of which are still being resolved. These problems have included possible hazards to beneficial insects including honey bees, predators, and parasites; hazards to improperly protected or uninformed applicators; a trend toward resistance of insects to the action of certain insecticides; the prevention of objectionable residue deposits on edible crops; and meeting an increasing number of restrictions on the sale, use, and application of

insecticides and on the harvesting, sale, and use of treated crops. Fortunately most of these problems are capable of being solved or minimized through education and research without sacrificing the benefits received from the improved control of injurious insects.

The problems created by insects of economic importance in Arizona now require the attention of numerous public and private agencies. The Arizona Commission of Agriculture and Horticulture is responsible for preventing the introduction and spread of dangerous plant pests. The United States Department of Agriculture participates in this co-operative work and is particularly concerned with the eradication and control of local outbreaks of insects of national importance and the control of important pests on publicly owned range and forested areas. It also enforces quarantine regulations pertaining to the entry of plants and plant products from Mexico.

The University of Arizona is actively engaged in teaching, research, extension, and regulatory work relating to insects of economic importance. A full undergraduate and graduate teaching program is offered. Through the Agricultural Experiment Station, various University of Arizona entomologists are engaged in research projects dealing with the identification, biology, and control of the insects of greatest economic importance and with insecticides and related problems. Research is conducted on a state-wide basis with the aid of three field laboratories. Through the state chemist, the University of Arizona administers laws relating to the composition, registration, and use of insecticides in the state. Instruction in entomology is also offered at Arizona State University and Arizona State College. The Arizona Board of Pest Control Applicators regulates the commercial application of insecticides and in an average year will license about thirty companies operating about 200 airplanes.

The United States Department of Agriculture has contributed much to our knowledge and control of Arizona insects of economic importance through its research laboratories maintained in cooperation with the University of Arizona.

Animal Husbandry

BEEF CATTLE. Beef cattle were second only to cotton as a source of cash income from Arizona farms, feedlots, and ranches in 1958. Lands used for grazing make up about 85 percent of the total



— *Western Livestock Journal*

Cows and calves on summer range, Apache County

land area of about 72 million acres and have characterized Arizona chiefly as a range state. Since 1940, when Arizona had some 64,000 cattle on feed, the state has increased rapidly as a feeding state, producing 400,000 fed cattle and calves in 1958. Thus, the change from obscurity to the rank of one of the major feeding states of the nation has been accomplished in recent years as more feed crops have been produced on irrigated lands. Arizona is a surplus cattle-producing state but a deficit area in meat processing. Population growth has exceeded the expansion in packing house facilities and capacity, although there are approximately fifty establishments in Arizona licensed to slaughter livestock.

Cattle Numbers and Income. Income from cattle and calves was 101.5 million dollars in 1958. Of this, 30.5 million dollars is estimated to be the value of weight gained on cattle in Arizona feedlots. Total shipments of cattle and calves out of the state during 1958 were 563,069 head. Inshipments were 388,360 head. The growth of feedlots has prompted

the increase in inshipments from an average of 59,000 head in the 1930-34 five year period. Inshipments come from many sources, including Mexico and as far distant as Florida.

As of January 1, 1959, Arizona was credited with 884,000 beef cattle of which 451,000 were cows and yearling heifers. Whereas the state's cattle population has not changed materially since the turn of the century, the number of range cattle has decreased and the number of other cattle, such as feeders in commercial feedlots, has increased.

Numbers of purebred registered cattle have increased gradually. Herds of Hereford, Angus, Brangus, Santa Gertrudis, Charolais, and Shorthorn are found in the state. Herefords predominate in numbers of both herds and cattle.

Feedlot Operations. Arizona has feedlot capacity for approximately 325,000 head, with individual size of feedlots ranging from a few hundred to 35,000 head. Some lots own all the cattle fed in that lot, others are custom feeders, feeding for other

owners, and a third type of operation is a combination of the above two methods. The bulk of fed cattle shipped out of Arizona go to California. The most common marketing practice for fed cattle is direct sale from the feedlot.

The increasing productivity of tillable irrigated acres, the growing human population, and the necessity for further diversity of big farming companies have made cattle feeding a natural part of Arizona's recent growth. The feeds commonly used are alfalfa hay, milo, barley, cottonseed products, and silage. Alfalfa green-chop programs are followed in certain areas such as Yuma. Large trench silos, mechanical equipment, and the practice of double cropping the forage sorghums for silage have made silage a popular and economical feed for many operators. Approximately thirty to forty-five tons of silage per acre are produced by double cropping. At certain times many by-product feeds, such as vegetable waste, cantaloupe meal, cantaloupe silage, or citrus pulp are used, especially in the Yuma area.

A majority of the feedlots have their own feed-processing equipment concentrated in a feedmill installation. These plants usually include, besides grain storage, a large capacity hay grinder, grain-rolling mills equipped with steam plants, elevators, molasses blending equipment, and provisions for the addition of fat or grease to the ration. Practically all hay is baled and stacked in neat bale piles in the vicinity of the feedlot, but is fed almost exclusively as ground or chopped hay. The feeding of total mixed rations is the rule rather than the exception, with starting rations formulated for 30 percent concentrates and finishing rations running 65 percent or more in concentrates. Both percentage and batch-type mills are found in Arizona. Self-unloading trucks, fence line troughs, and well arranged yards allow a few men to feed several thousand head of cattle. Most lots feed from two to five times daily and the troughs are never without feed. The feedlots are designed without the usual shelter or windbreaks, but with some provision for shade. Experimental work at the Yuma Experiment Station has shown that forty square feet of shade per steer will save several dollars per hundred weight in producing gains on cattle of the English breeds during the warmer months of the year. There is a preference among feeders for cattle showing some Brahman blood for summer feeding in Arizona.

The Arizona Cattle Feeders' Association is an active and growing organization of cattle feeders

with headquarters in Phoenix. Similarly, the Yuma Cattle Feeders' Association, with a number of members from Southern California, represents feeders in the Yuma and Imperial valleys. The Arizona Cattle Feeders' Association has an active research committee working closely with the Animal Science Department on needed and appropriate research with feedlot problems and cattle.

Ranch Organization. Yearlong grazing on definite ranch units is a nearly universal practice in the state. Carrying-capacity of ranches varies from 100 to 2,500 or more breeding cows. In general, ranch units are under fence and comprise privately owned, state owned, and federally controlled lands under lease. The bulk of the range area is under public control, falling within grazing districts, Indian reservations, national forests, and state lands. The more desirable portion of this area falls within elevations of 3,000 to 6,000 feet. Range lands also include many desert areas which are used by livestock in winter and spring and in other seasons with good rainfall. In addition, there are mountain areas which, because of altitude and climate, are suited only for summer grazing, often with steers.

Calving seasons vary with the area, but the big movement of feeder cattle from the ranges is in the fall months. A second seasonal movement is in the spring and includes feeder cattle from those ranches selling spring yearlings. The demand for feeder cattle by the feedlots of the state is yearlong, with many operators buying and selling cattle every week, or at least every month of the year.

The Arizona Cattle Growers' Association is an organization of the state cattle producers and has for years been one of the prominent and influential state organizations of the nation.

Ranching Areas. While cattle ranching is a statewide activity, it can be divided into five areas differentiated principally by vegetation types, ranching methods, and location. Their designation and a brief description of each follow.

MOHAVE STRIP. The entire northwestern portion of the state lying beyond the Colorado River is designated as the Mohave Strip. The deeply cut canyon of the Colorado River forms a natural barrier isolating this area from the rest of the state. The Kaibab Plateau which borders the Grand Canyon and extends northward toward Fredonia has been closed for a number of years to all but a limited number of livestock. In House Rock Valley to the east of the plateau there is open grassland used by cattle.



Ewes and lambs on summer range — St. Mary's Lake area of Coconino County

North and west of the plateau is a large area of the northern desert type range being used by a few flocks of sheep from the bordering state of Utah.

NAVAJO INDIAN RESERVATION. The Navajo Indian Reservation in northeastern Arizona constitutes an area of 12,000,000 acres or one-sixth of the state's total area. It is used almost exclusively by the Indians for grazing livestock—more sheep and goats than cattle.

SOUTHWEST DESERT. This area stands apart from the rest of the state because of its limited use as grazing land. It consists almost exclusively of the desert-type vegetation. It embraces all of Yuma County, western Pima and Maricopa counties, and southern Mohave County. Only in certain areas are cattle raised on a permanent basis. Some areas contiguous to the Salt River and Yuma valleys are used by cattle and sheep for late winter grazing. With the development of irrigation farming, the feeding of cattle and production of purebred cattle have increased rapidly.

SOUTHEASTERN AREA. The southeastern area includes all of Cochise and Santa Cruz counties and more than half of the adjoining counties of Graham, Pinal, Pima, and southern Greenlee, all lying south of the Gila River. Approximately one-third of the range cattle are to be found in this area. It is particularly well adapted as a cattle breeding country and for the production of early spring calves. For the most part it affords yearlong grazing on ranges that are largely grassland bordering on scattered mountain ranges and some desert strips at the lower elevations.

CENTRAL MOUNTAIN AND FOOTHILL AREA. The central mountain and foothill area circumscribed by the four districts just described is the principal

range livestock section of the state. Most of the sheep owned by White people and more than half of the cattle are in this territory. It lies in a diagonal direction northwest and southeast, centering on high mountain ranges. Pronounced topographic features and wide differences in climate account for the presence of the several vegetation types and as many systems of range livestock raising. The various forms of land ownership are also represented. The national forests and Indian reservations administer practically all of the grazing in the mountain ranges. Separate allotments for cattle and sheep are provided wherever possible on the forest.

RESEARCH AND EDUCATION. The Animal Science Department of the University of Arizona works closely with both the cattle feeders and cattle growers in the matters of research and education.

Research projects dealing with problems of cattle production or feeding are conducted by the Arizona Agricultural Experiment Station at both Yuma and Tucson. In addition, some problems are studied cooperatively with producers and feeders. Currently, several animal breeding projects are being carried on cooperatively with individual ranchers and with the San Carlos Apache Tribal Enterprises. A total of eight faculty and three staff members make up the teaching, research, and extension group in Animal Science. The University of Arizona Animal Science Farm at Tucson maintains herds of registered Hereford and Angus cattle.

The Sheep Industry. Arizona's sheep population, following a steady decline over the past twenty-five years, has become stabilized at a level of approximately 300,000 breeding ewes. Over 200,000 of these are Indian-owned on reservations. The Navajo flocks predominate. The remaining White-owned

ewes are grazed on the north central mountain range area of the state, and wintered on irrigated pastures in the lower valleys. These sheep, bred for early lamb production, rely almost entirely on alfalfa together with some barley and oat crops as winter pasture feed.

Outfits start lambing in early November and continue for a period of about forty days. Both ewes and lambs are kept on pasture until the lambs reach market finish in April. Under this practice the ewes are shorn in February and March and are returned to their summer ranges soon after the lambs are marketed.

Confronted with high pasture costs, sheepmen are seeking an alternative method to the long-established pasture system. A continuing high level of green-feed prices, death losses from bloat, and a declining source of available pasture may eventually lead to pen-feeding or some modification of the present practice.

Considerable interest in ewe flocks has developed in the Yuma area. Alfalfa pasture and Bermuda straw are the principal feed crops in this program.

A total of 3,131,000 pounds of wool was produced in Arizona in 1958. It sold for approximately thirty-six cents per pound, exclusive of the federal support payment. The major portion of the state's wool clip, exclusive of the Indian-owned sheep wool, is marketed through the Arizona Wool Growers Association, a subsidiary of the National Wool Marketing Association.

BREEDS. Arizona range sheep owned by Whites are almost exclusively Rambouillet. The Indian-owned sheep are of less well-defined breeding. Rams of the Hampshire and Suffolk breeds are used exclusively by the White operators for producing market lambs. Breeders of registered sheep are few in number. Arizona State University maintains flocks of Rambouillet and Suffolk, and the University of Arizona raises Rambouillet, Hampshire, and Suffolk.

LAMB FEEDING. Commercial lamb feeding is of little importance in the state. Currently, only one major feed yard is in operation. The bulk of the fat lambs marketed are sold direct from the irrigated pastures of the Salt River, Casa Grande, and Yuma valleys.

THE DAIRY INDUSTRY. Dairy farming in Arizona is a highly competitive and specialized industry, characterized by large-sized herds which are becoming larger. At the same time, small herds are being consolidated or sold. In the past decade the average

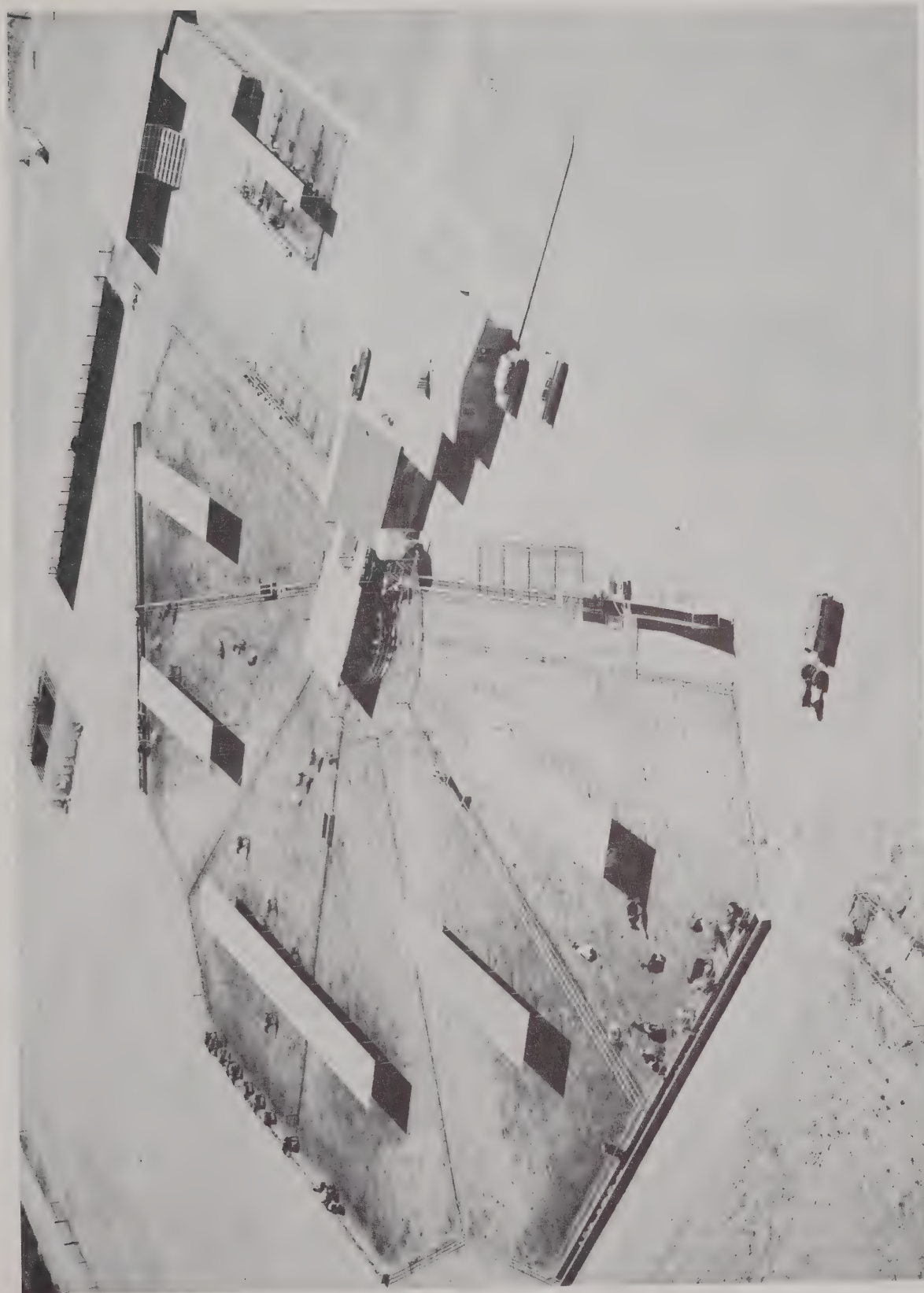
number of milking cows per herd (on Dairy Herd Improvement Association test) has doubled. At the beginning of 1960, this stood at an average of 125 cows per dairy farm with a total of approximately 480 dairy farms in the state. The total dairy cattle population is between 100,000 and 105,000 of which 51,000 are milking cows. Although the state of Arizona ranks only forty-third in the total number of dairy cattle, it ranks fourth in average yearly production per cow of 8,140 pounds of milk and 293 pounds of fat. Arizona also enjoys the enviable reputation of having a greater percentage of cows on test, 46 percent, than any other state.

Dairy farming is limited to the irrigated sections of the state. About 75 percent of the dairy cattle are in the Salt River Valley of Maricopa County. The other 25 percent are in the irrigable valleys of the upper Gila, Casa Grande, Santa Cruz, Chino, Verde, San Pedro, Sulphur Spring, and Yuma. There is some dairying in the Joseph City and Snowflake areas of Navajo County, and there is a trend for dairy production to increase in areas other than in Maricopa and Pinal counties.

Prolonged high summer temperatures, particularly in Yuma, Maricopa, and Pinal counties, have a depressing effect on milk production and breeding efficiency. Fall, winter, and spring temperatures in central and southern counties are more favorable for maximum production. Because of favorable climatic conditions in all of Arizona, the requirements for housing are minimum. The dairy cows are maintained in open corrals and are milked in milking parlors. Shades are essential for maximum production in the central and southern counties.

With the smaller herds of former years, most of the feed was home-grown. With the large herds, however, a large portion of the feed is purchased. Alfalfa hay is the basis for most dairy cattle rations. There is an abundance of alfalfa grown in all irrigated sections of the state, because alfalfa is popular in crop rotation. The quality of alfalfa hay produced in the state is excellent because of the favorable weather conditions for curing. In some of the southern counties, five to eight cuttings of alfalfa are made per year. Other roughages that are used quite extensively are grain sorghum for silage, grasses of cereal grains, sudan grass, and alfalfa for green chop and silage. For all practical purposes, pastures are not used for milking cows. Pasture is used primarily for young stock and dry cows.

Barley and hegarí are the principal grains used



— Ray Manley

A modern dairy plant — the Dairy Research Center at the University of Arizona, Tucson



Poultry ranch — egg production increases match population growth

in dairy concentrate mixtures, and provide a relatively cheap source of energy. Because cottonseed meal is locally available and competitive in price, it is used extensively in concentrate mixtures. It is needed as a source of protein when the bulk of the roughage is other than alfalfa hay, but when alfalfa hay is fed liberally, the protein of cotton seed meal is competitive with that of barley and hegar on a total-digestible-nutrient basis. Some whole cottonseed is used either as a part of the concentrate mixture or fed alone by a few dairymen.

Five major dairy breeds — Ayrshires, Brown Swiss, Guernseys, Holsteins, and Jerseys—are represented in the state. Approximately 90 percent are Holstein, and 5 percent Guernsey, with Jerseys, Brown Swiss, and Ayrshires making up the other 5 percent. A few dual-purpose cattle are maintained.

The Central Arizona Milk Marketing Order was voted in by the dairy producers in 1955. This order covers the central and southern counties of the state. It sets the minimum prices paid to producers for milk, based on a formula which takes into consideration the price paid for manufacturing milk in the Midwest and the local cost of production. The supply-demand clause in this order is such that the price paid producers for milk is depressed when the supply of milk for Class 1 utilization, fluid milk, is greater than the demand, and conversely. The local cost of milk production does not encourage the production of milk for manufacturing purposes. The

market order is administered by the United States Department of Agriculture.

The processing plants for milk are confined largely to the population centers of Phoenix and Tucson. A high percentage of the milk produced in the state is used for fluid consumption. The excess over fluid needs is used mostly for the manufacture of ice cream and cottage cheese. Practically all of the cured cheeses, butter, evaporated and condensed milk, and powdered whole milk are shipped into Arizona. There is a limited amount of powdered skim milk and butter produced in the state.

POULTRY. The gross income from poultry products on Arizona farms has increased from \$2 million in 1935 to \$5,834,000 in 1958. Most of the poultry income, 85.4 percent, came from sale of eggs and chickens. Turkey and broiler sales contributed 8.6 and 6.0 percent, respectively, to the gross receipts. Additional minor income was derived from ducks, geese, and rabbits.

Major poultry enterprise in Arizona is production of eggs for market. A few poultry operations are associated with other agricultural activities, but most poultry plants are specialized farms where a large number of laying hens are kept in special buildings on small acreages.

Greater specialization in poultry production has brought larger units. In 1957, 57 percent of poultry farms had 1,000 to 5,000 birds, and 12 percent had more than 5,000 birds each. Average production per

hen increased from 155 eggs per year in 1947 to 200 in 1956. The number of laying hens reached the 600,000 mark in 1958.

The population of Arizona represents a large market for eggs. During 1957, there were only 7.6 million dozen eggs produced in the state. To feed the increased human population, which has now reached 1,287,000, almost three times that many eggs are required. Approximately 50 percent of the eggs consumed in Arizona are shipped in from out-of-state points. In 1953, the imported eggs represented 5.8 million dozen. This amount increased to 11.3 million dozen in 1955, and declined to 9.8 million dozen in 1956.

From 1953 through 1956, California has been the principal point of origin for eggs shipped into Arizona, furnishing 58 percent of the total inshipments in 1956. It is followed by the midwestern states of Nebraska, Kansas, Colorado, Minnesota, Iowa, and South Dakota, ranked respectively.

The general tendency of the poultry industry to locate itself near densely populated centers for easy marketing is noted in Arizona. Maricopa and Pima counties, with the two largest metropolitan areas, are also the largest egg-producing areas. Half of Arizona's poultry population is located in these two counties.

Arizona markets have for some time maintained higher wholesale and retail prices for poultry products than those in neighboring states. A favorable price differential, coupled with a deficiency of local products, places the industry in an enviable position in Arizona. However, improved packing and transportation facilities in California and in the midwestern states have made it possible for poultry products from these areas to be shipped into Arizona at competitive prices.

The Arizona Egg Law was enacted in 1955, setting standards of quality grades and sizes. The law requires that the temperature of eggs must be held below sixty degrees Fahrenheit by the dealers and retailers. This prescribed temperature feature for egg handling is found in the egg laws of only five other states. All handlers of eggs sold in Arizona are subject to the Arizona Egg Law, whether the product is produced in the state or shipped in. The law is administered by a state egg inspector appointed by the governor.

Poultry producers are serviced by franchised hatcheries which obtain foundation stock yearly from the major breeders, and proceed to "multiply"

them for the local producer. The hatcheries cooperate with the National Poultry Improvement Association, which assures that the chickens are from pullorum-inspected and tested flocks. In the past year more than two million chickens were sold by Arizona hatcheries.

Generally, in Arizona, the egg producer sells his product to the processor, either ungraded, graded for size, or graded for size and candled. Producers in all major egg-producing areas of the state may call on several processors for service. A significant portion of the eggs is marketed by the producer directly to the retailer, and a few are marketed to the consumer.

Some diseases are prevalent in the poultry flocks of the state, but not to the extent found in areas where rainfall is heavy or where the poultry population is greater. Educational activities and cooperative inspections have aided in the control of poultry diseases and have been major factors in preventing epidemics. The University of Arizona operates two diagnostic laboratories, staffed by veterinarians and technical personnel, where free diagnostic services are available to poultry producers.

Turkeys are the second most important poultry product of the state. Most of the turkeys are produced in large flocks on a year round basis. Some of the producers dress and market their turkeys through their own facilities, but most of the live turkeys are handled by commercial processors.

Processing plants in the Phoenix and Tucson area also handle the bulk of the cull hens, and distribute shipped-in broilers. Local plants distribute close to five million broilers a year for local consumption. On January 1, 1959, the new Federal Poultry Inspection Law went into effect. This regulation applies to inspection of poultry and poultry products in interstate or foreign commerce and in designated consuming areas.

The Department of Poultry Science at the University of Arizona, established in 1919, and the Southwestern Poultry Experiment Station at Glendale, established by the U. S. Department of Agriculture in 1921, are actively engaged in research embracing all fields of poultry production. An egg-laying contest—in which breeders from all over the country participated—was conducted by the University of Arizona Poultry Science Department for about twenty-five years. This program was terminated in 1952, but two years later the Poultry Science Department at Arizona State University in-

stituted a random-sample contest in its stead.

A new Poultry Research Center established by the University of Arizona was completed in 1955, providing poultry housing, hatching, brooding, feed-mixing, and laboratory facilities for instruction and research.

Development of inexpensive raised-platform poultry housing was pioneered by the workers at the Southwest Experiment Station at Glendale. Subsequently, University of Arizona Extension Engi-

neers have redesigned and modified these structures for use in more efficient commercial operations. Mechanical cooling by means of mist, sprays, water coolers, natural shade, and ground cover have been studied by Arizona poultry researchers. State and federal personnel have been engaged in the development of a heat-resistant strain of single-combed White Leghorn. Several projects on specialized feed additives during hot weather, and the effect of such supplements on the quality of the egg are in progress.



— Chuck Abbott

Cattle grazing in a pasture of wildflowers

..... *tourism and recreation*

IN MODERN TIMES MAN'S BASIC NEED FOR recreation and rest has become almost universally recognized and consequently one of Arizona's great resources has come into its own. Like the underground waters and rich veins of ore, the stream of tourists to Arizona is an integral part of the state's resources, tributary to the natural resources which comprise its wealth.

Travelers to Arizona in 1959 spent an estimated \$280,000,000 searching for change of climate, scenery, and total environment. This represented an increase of \$100,000,000 over 1955 tourist expenditures. Other things being equal, experts predict a doubling of domestic tourist spending in the United States by 1975. With Arizona high on the preferred list of recreational havens, there is little question that its tourist industry can continue to flourish.

Nor can it be questioned that tourism is an industry. Frequently in discussions of industrial development, the word industry is assumed to mean manufacturing. If, however, industry is defined as any organized economic activity or group of related activities, directed toward the satisfaction of human needs and wants, then manufacturing is only one type of industry. Mining is another, agriculture is still another, and the care of travelers is certainly also a type of industrial activity.

The desire for industrial development seems to highlight the economic thinking of most contemporary Arizonans. Certainly there has been in Arizona as elsewhere, a post-war focus on efforts to bring more industry into the area. Practically all communities of any size in Arizona have wished or ne-

gotiated for the arrival in town of a manufacturing industry with plant, sizeable payroll, and minimum qualifications of cleanliness and civic-minded management.

Tempting as are the possibilities of this type of development, there are related problems. First of all, there may not be enough clean industries with civic-minded management to go around. Also, industries are not inclined to be footloose. Most of them are oriented toward unusual supplies of labor, power, raw materials, and research facilities, readily available markets, transportation, and relevant industrial complexes. Arizona communities are not always able to fill these basic needs.

The tourist industry, on the other hand, does not make such demands. Skilled labor pools, large markets, huge quantities of available power, and research are not so very essential. On the other hand, natural resources—recreational areas, scenery, prehistoric sites, national parks, benign climate—all things with which Arizona is blessed, are the stock in trade of tourism.

Arizonans eager to develop other industries can reassure themselves that many types of industry can develop harmoniously with tourism; that except for somewhat higher retail prices in a tourist-oriented economy, and the slightly depressing effect of sales tax on necessary items, there is no evidence that tourism is a detriment to other kinds of industrial development. They might also remind themselves that to any community in Arizona, eleven touring parties are worth one manufacturing industry with a \$100,000 payroll, and that in one year eleven such parties will spend approximately \$30,000 in the

restaurants, lunch counters, grocery stores, and specialty food stands of the community. Much of that money will in time find its way back to farmers and stock raisers of the state. Approximately \$22,000 will be paid to motel, hotel, resort, apartment, and trailer-park owners. Another \$18,000 will probably be spent in service stations and garages, and \$19,000 in other retail outlets. About \$11,000 from these tourist parties will go to operators of community recreational and entertainment facilities.

Natural resources are the *sine qua non* for a successful tourist industry. There are other important concerns. The condition of major highways leading into and out of the tourist area must be considered, not only with respect to comfortable riding, but also to proper treatment of travelers by hotels, motels, and restaurants. Traffic hazards, availability of secondary roads leading off to points of sight-seeing interest, all are problems to be solved.

Promotion too is an everpresent concern. Competition is becoming strong enough to keep the most alert protagonist of Arizona travel on edge. The new states, Alaska and Hawaii, both are strong rivals of the Southwest for tourists. So are Europe and the Far East, with lowered fares and advantageous rates of exchange a growing temptation to mobile Americans. The winter tourist industry in Arizona has felt already the competitive winds from the rapidly expanding attractions in the Caribbean with 185,000 vacationers heading for the Virgin Islands alone in 1960.

Doubts can be easily quieted, however, about the ability of Arizona to produce the natural commodities the tourist is seeking. From the aspen-clad hillsides, mountain meadows, and snowy peaks of the north, to the cactus-studded neighborhoods on the south, bordering Mexico, Arizona is a panorama of what the tourist seems to want. The climate is legendary—dry air, clear skies, indefatigable sun. Even apart from such marvels as the Grand Canyon and the Petrified Forest, Arizona's scenery is dramatic—rocky cliffs, undulating pastures, deep forests, the dream-world vegetation of the desert.

Sports — Spectator and Participation

Because of the temperate climate and greatly varied geography of Arizona, sports play a great role in the leisure time of tourists and residents. The year-round warmth of the desert regions gives Arizona a wide edge in outdoor sports, and spring sports have an opportunity to blossom as in few other states



— Chuck Abbott

Campers seek out canyon beauty spots like Aravaipa Creek in southern Arizona

in the country. The biggest professional attraction is the "Cactus League"—the four major league baseball teams which train each spring in Arizona. With the San Francisco Giants at Phoenix, the Cleveland Indians at Tucson, the Chicago Cubs at Mesa, and the Boston Red Sox at Scottsdale, residents and visitors have an opportunity to witness some of the nation's top players in action. At Casa Grande plans have been developed for a large minor league training camp for the San Francisco club, and in 1960 a new winter professional league for young players was inaugurated.

Another big professional attraction is the annual winter appearance of the world's top golfers. They play in the Phoenix Open and in the Tucson Open



— W. G. Carroll

Cape Royal, North Rim of Grand Canyon — dramatic view of famed tourist attraction

for prize money that totals some \$50,000.

Professional sports also include wrestling in many cities, irregularly scheduled boxing matches, and softball.

Racing fans find plenty of opportunity to enjoy their hobby. Horse racing, a natural sport for a western state, has grown tremendously. Supplementing the major tracks in Phoenix and Tucson are the county fair meets in cities throughout the state. Greyhound racing is on a major level with three tracks in the Phoenix area and another track in Tucson. Auto racing enthusiasts find sprint, sport, and midget events with nationally-known drivers competing.

Because of the remarkable climate, Arizona is a haven for participation sports. The state has large

desert regions, but it also has several good-sized lakes, and boating in the state is following the national boom. Arizona lakes are filled throughout the year with boating and water skiing enthusiasts, and major boat and ski races are held on Lake Mead.

Winter sports continue to grow in importance in Arizona. Even residents of the desert are but a few hours' drive from the fine facilities of the Arizona Snow Bowl near Flagstaff, and skiing, tobogganing, and ice skating are available on Mt. Lemmon near Tucson.

With the natural environment favoring outdoor life for every group, regardless of age or ability, amateur sports are very important in the state. Athletic teams at the University of Arizona, Arizona



Mountain snows lure winter sportsmen

State University, Arizona State College and Phoenix College have high national ranking. Collegians from various Arizona institutions have won individual championships and positions of leadership. Swimming on a year-round basis has become more and more common with almost every community having at least one municipal pool, and city-wide meets providing competition for outstanding performers.

Four young Arizonans participated in the 1960 Olympics—Dallas Long, shot-putter from Phoenix; Patsy Willard, diver from Mesa; Alphonso Morales, U.S. Navy fencer from Tucson; and Nelson Lincoln, marksman from Flagstaff.

Arizona's colleges, in developing amateur sports events, are drawing good material from the state high schools where athletics are also prominent. All prep sports are well-developed with state-wide championship events occurring throughout the year.

Among sports for amateur participation, tennis is popular, and major clubs in Phoenix and Tucson aid in developing nationally-ranking players. Golf

courses are being built in record numbers, many of them on historic sites such as that of Tubac Country Club in the picturesque Santa Cruz valley.

Bowling is another popular participation sport and the nation-wide boom in bowling alley construction is reflected in Arizona where statewide tournaments are held annually. Trapshooting, rifle-shooting, and marksmanship and archery as well have thousands of enthusiastic followers among Arizona residents and visitors.

Developed both as a recreational pastime and a sporting skill are hunting and fishing—major outdoor activities for a tremendous number of Arizonans and tourists. The state has ten big game animals, ranging from desert floors to snow-capped mountain areas. Deer hunting on the Kaibab Plateau is famed over the nation. The lakes and streams of Arizona provide good fishing, and Arizonans craving deep-sea fishing have only to journey a few hours over roads that are steadily being improved to reach the many fishing ports in Mexico on the Gulf of California. At Puerto Lobos, Libertad, Guaymas, Desemboque, Cholla Bay, and other points on the gulf, the thrilling battle with big game fish, skin-diving, and all seaside recreation can be pursued on fantastic white-sanded beaches where rare cactus plants guard calm salt waters.

Recreation — North and South

The same short step to the south takes the tourist to the storied Mexico of mariachi music, paper flowers, the brave bulls, and exotic wining and dining. Nogales, Sonora, an hour from Tucson, is a picturesque hillside town with a gay border atmosphere and an abundance of curios. Hermosillo, the capital of Sonora, is only another four hours drive on a fine highway.

North in Arizona tourist attractions are also numerous. The winter sports that are available in the vicinity of Flagstaff and San Francisco Mountains, and the summer trout fishing in the White Mountains are both made more attractive and readily available by plentiful government recreation areas for tent and trailer campers, and lodging in picturesque mountain villages of log construction.

It is easy for the tourist in northern Arizona to vary his program with visits to Indian country. Endless stretches of barren land, red sandstone cliffs, pueblo ruins, hogan homes of living inhabitants, shepherds, silversmiths, and weavers—such people dominate the quiet life of Navajo and Hopi



Arizona lakes provide year-round opportunities for water sports

reservations and stimulate the interest of tourists all over northern Arizona.

In vast and awesome Monument Valley, the Navajo Tribe itself has established the first of a series of tribal parks. A \$166,000 glass-walled observatory commands a view of the red sandstone buttes which Nature, through the centuries, has eroded into fantastic forms. Fourteen miles of trails tempt the visitor, and camping facilities are available.

Indian ceremonials fill the calendar throughout the state. On the edges of downtown Tucson and Phoenix, the Yaquis dance through Holy Week to the climax of an Easter ceremonial combining Christian and tribal religious rites. Community leaders

both Indian and White have joined elements of regional history in a colorful April pageant at San Xavier del Bac, Tucson's beautiful old mission known as the White Dove of the Desert. Indians of many western states converge among the pines of Flagstaff in July for the Pow-Wow, and the Hopis perform their annual snake dances on their reservation north of Winslow in August. The Smokis dance in August also at Prescott.

Rodeos are even more numerous. Tucson has the Fiesta de los Vaqueros in February. Phoenix brings top hands to its rodeo in March. Broncos buck amid cool breezes at Prescott in July and Payson in August. Benson and Holbrook have rodeos in September. Tombstone has for years staged its



— Esther Henderson

Earth and sky provide a visual harmony delighting visitors to Monument Valley

annual Helldorado, and in Wickenburg, Gold Rush Days offer a chance to pan for gold. In October the Papagos ride in a rodeo and hold a famous annual fair on the reservation at Sells. In addition to these and many other similar events, both state universities hold major rodeos every year.

In the metropolitan areas of Phoenix and Tucson, calendared events highlight a daily life that is an engaging mixture of regionalism and sophistication. Visitors eat Mexican dishes and listen to guitar music, lie in sun-filled patios, attend flower and fashion shows, ride in convertibles and on horseback, eat steak and beans by moonlight, and swim in January all over southern Arizona. They shop in air-conditioned stores for an endless list of nationally-advertised products. They go downtown in levis and shorts and mingle with busy crowds wearing smart cotton dresses and suits, or broad-brimmed hats, high-heeled boots, western shirts and pants.

The Arizona tourist very frequently returns to the state to make his home and become the Arizona resident. In the homes of Southwestern friends he has found interiors gay, social life spontaneous, and living easy. He has found fine schools for his children, and churches and civic organizations to broaden the scope of his family life. Most important of all, and the newness of the state notwithstanding, he has found that he can leave an eastern metropolis and move way out to Arizona at no sacrifice of convenience or constructive activity, and with great gain of comfort and pleasure in daily living.

As a permanent resident of the state, the returned tourist becomes a vital factor in the community. He appears statistically in the 71 percent population increase since 1950. He appears in countless other ways in his contributions of new talent, new ideas, and new energies to the rapid growth and the dynamic development of the state.

..... *transportation and utilities*

IN THE 1936 ISSUE OF *Arizona and its Heritage*, the late eminent historian, Dr. Howard A. Hubbard closed his article "Transportation" with the following statement:

The depression, the opening of airways, the development of good roads together with motor-bus and automobile travel, the competition of motor trucks have forced the railroad companies in Arizona, as in other states, to tear up the tracks of the weaker branch lines in order to reduce tax costs. It is not a wild flight of the imagination, however, to conclude that the untold narrative of Arizona's future, like the rich history of its past will be intimately and inseparably connected with the story of transportation.

Since any modern economy is highly dependent upon transportation for its very existence and development, and growth is retarded in the absence of good transportation, the prophecy quoted above carried very little risk. The state of Arizona, located as it is on the main southern east-west routes connecting California to the rest of the nation, has always been a "bridge" state with a great deal of through traffic of all kinds. As more and more people move into the "sunshine" areas, more and more passenger movements originate or terminate in Arizona. As more industries locate within the borders of the state, more and more freight terminates and originates within the state. The phenomenal growth of population and in industry in Arizona could hardly have been forecast, even as late as 1936.

Since Arizona was the forty-eighth state to come into the Union, the framers of the constitution had a considerable amount of precedent upon which to

base the laws fostering the growth and development of the state.

Recognizing the importance of proper control over the utility industries, the founding fathers made provision for a Corporation Commission which, among other duties, was given the power to regulate "public service corporations." These are defined in the constitution as corporations "other than municipal engaged in carrying persons or property for hire; or in furnishing gas, oil or electricity for light, fuel or power."

Since the railways were already operating over considerable rail mileage in the Territory before statehood, the constitution also declared that all railways "heretofore constructed or that may hereafter be constructed, in this State" be common carriers subject to control by law. Also included in this provision were "car, express, electric, transmission, telegraph, telephone, or pipeline corporations."

It was on this firm foundation that the new state, with a population of a little over 200,000 persons, took its place among the other forty-seven states in the Union. In the years since statehood, the population growth has been great. By 1959, greater Tucson had an estimated population greater than that of the entire state at the time of admission to the Union in 1912, and greater Phoenix in 1959 had an estimated population equal to that of the entire state in 1930.

The prophecy of Dr. Hubbard in regard to trends in rail mileage has proven correct in that the peak of mileage was reached in 1930 with 2,494 miles of line owned and operated by the two railroads serving Arizona. In 1958 that figure had fallen to 2,177

miles of line, a drop of 12.7 percent which was 0.5 percent greater than the national reduction of 12.2 percent for the same period.

Arizona is fortunate to have two of the nation's strongest railroad companies serving it and furnishing transportation service east and west, and also within the state itself. The Atchison, Topeka and Santa Fe Railway serves the northern part of the state with the main line passing through Winslow, Flagstaff, Ash Fork, Williams, and Kingman. Branch lines serve Phoenix and the Grand Canyon.

In 1958, the Santa Fe ranked fourth in operating revenues among the transportation companies of the United States and has always been a consistently strong rail carrier.

The Southern Pacific Company tracks pass through the southern part of the state, serving such cities as Douglas, Tucson, Phoenix, Gila Bend, and Yuma. Nationally, the Southern Pacific ranks third in operating revenues and, like the Santa Fe has always been a strong rail carrier. The Southern Pacific now operates two wholly-owned subsidiary transportation companies in the state of Arizona: the Southern Pacific Pipe Lines, and the Pacific Motor Transport, a truck line. In addition to this, the company is pushing ahead with another type of service known as "piggyback" where the company hauls truck trailers on its own flat cars. The advantages of this trailer-on-flat car service include greater speed (freight moving at passenger train speeds); rates competitive with highway carriers; pick up and delivery at each end; no weather delays; and virtually no loss and damage.

The Southern Pacific was the first rail company in the United States to use its right-of-way for a petroleum pipeline, thus furnishing Arizona with a different type of service, which lowers the cost of distribution of refined petroleum products to the consumers in the state. Gasoline, jet fuel, and other products from refineries around Los Angeles and El Paso are moved into the Phoenix and Tucson consuming areas by this pipeline.

Both railroads serving Arizona have specialized in providing rapid movement of perishables from the producing areas of the Southwest to the consuming centers of the middle and eastern markets—lettuce, cantaloupes, carrots, watermelons, potatoes, onions, cabbage, and other products. Well over 10,000 additional carloads of perishables moved from Mexico's west coast through the Nogales gateway to consuming points in the United States.

As it has throughout the nation, rail passenger service has declined to a marked degree in Arizona in recent years. Various factors have brought this about, including improved highways, busses, and air carrier service, and, most of all, the modern automobile.

Arizona is served by many small local bus lines and by two large interstate carriers, Southwest Greyhound Lines and Continental Trailways. Because Arizona is a "bridge" state, these two lines provide excellent service to all points east and west from the major cities in the state, with rapid, limited-stop schedules as well as local service. The national program of modernizing the highways will materially improve operating conditions for bus operators as well as truck operators in Arizona, along with the rest of the states, but it will also increase the competition of the private automobile, which in 1959 was estimated to be moving 90 percent of the intercity passenger traffic in the United States.

Indicative of the growth trend, truck registrations in Arizona increased from 78,657 in 1953 to 105,533 in 1958, which is a 34 percent increase compared to the national increase during the same period of 16 percent. In 1959 there were fifty-six motor truck firms providing truck service to and from all parts of the United States.

The state of Arizona maintains checking stations on all highways entering the state and the records from these stations show that as many as 13,000 commercial vehicles entered the state during certain months in 1958 and 1959. The same records indicate that a total of 36,635 motor vehicles of all kinds entered the state in July, 1959, which was an increase of 8 percent over the same period in 1958.

It has been estimated that tourists spent a total of \$280,000,000 in Arizona during 1959. Of this amount, it is estimated that \$82,320,000 was spent directly and indirectly on transportation, broken down as follows: service stations (gas and oil), \$43,680,000; auto accessories and repairs, \$18,760,000; and other transportation, \$19,880,00.

Nogales, Arizona, has become an important gateway for tourists and trade with its neighbor to the south, Mexico. In September, 1959, 2,382 cars and 3,948 persons entered Mexico through this port, an increase of 25 percent in cars and 38 percent in persons over September, 1959. These figures were exceeded only by the port of Laredo, Texas.

In 1959, the Arizona Customs District reported



— Ray Manley

The 12,000-foot runway at Tucson Municipal Airport — longest commercial runway in the continental United States

the value of exports to Mexico as \$32,089,035 versus a total of \$19,594,000 in 1944, and of imports as \$57,546,875, as compared with \$21,007,000 in 1944. These totals are indicative of the tremendous growth in trade with Mexico through the state of Arizona. Much of this trade consists of fresh fruits and vegetables from Mexico, and of machinery and other manufactured items moving into Mexico. No estimates are available of the amount of money spent by tourists and others in the border towns adjacent to Arizona.

Along with other forms of transportation, air service has increased tremendously in a relatively short time. In an area where the terrain is difficult to traverse and the distances great, the airplane is an especial boon to rapid travel. Arizona is served by two transcontinental airlines, American Airlines and Trans World Airlines, both of which provide non-stop service from Phoenix and Tucson to Chicago and New York City, and regular flights to all

points east and California. Elapsed time to Chicago is five hours, and to New York six and one-half. Jet service has reduced this time by two hours. From Phoenix it is possible to fly direct to 102 cities in the United States, and to get connections to any city in the world having commercial air service.

In addition to the transcontinental lines, Arizona is served by Western Airlines, which provides service to such cities as Denver, Minneapolis, and Seattle, as well as to the main cities of California.

Local service is provided by two scheduled interstate lines, Bonanza Air Lines and Frontier Airlines, and by one intrastate carrier, Apache Airlines. The latter, operating small planes, provides seven round trips daily between Phoenix and Tucson, and four between Tucson and Fort Huachuca.

Bonanza provides daily flights between Phoenix, Yuma, Prescott, Kingman, Flagstaff, Grand Canyon, and Page, as well as giving service from these Arizona points to southern California, Las Vegas



— AiResearch Mfg. Co.

Phoenix Sky Harbor Airport with AiResearch Manufacturing Co. in foreground. Sky Harbor ranks third nationally in volume of air traffic

and Reno, and Salt Lake City. Frontier Airlines connects Clifton, Safford, Tucson, Phoenix, Prescott, Flagstaff, and Winslow, Arizona, with cities in New Mexico, Colorado, Utah, Wyoming, North and South Dakota and Nebraska.

Southern Arizona, blessed with good flying weather virtually all year round, and with excellent airports at Phoenix and Tucson, continues to increase as an air transport center. The Phoenix airport ranked second in the nation in the volume of air traffic during 1959. In the fall of 1960 Tucson became an international port with Aeronaves de Mexico providing flights to Mexico City and points on the Pacific.

Telephone communication is provided by the Mountain States Telephone and Telegraph Company for the majority of the state, while the General Telephone Company and a few small independent firms serve some of the communities in the northern part of the state. In all cases, the lines of these other firms are tied in with those of the Mountain States

company for national and international service.

As with other industries, the telephone companies have felt the tremendous growth occurring in Arizona, and these firms have spent millions of dollars in recent years to provide the expanded facilities necessary to keep up with the growing population. The majority of the towns in the state now have a dial system, and many cities now enjoy dial-direct service in the state and the nation.

A few statistics serve to illustrate the growth of the telephone industry. Between 1940 and 1950, Greater Phoenix showed an increase of 192 percent in the number of telephones in service, while the increase in Greater Tucson for the same time was 202 percent. In the ten years between 1950 and 1960 telephones in service in the Greater Phoenix area rose from 72,749 to 216,780 for an increase of 198 percent, while in Greater Tucson during the same period the number of instruments increased from 35,967 to 91,850, for a gain of 155 percent. Growth throughout the state has been comparable.



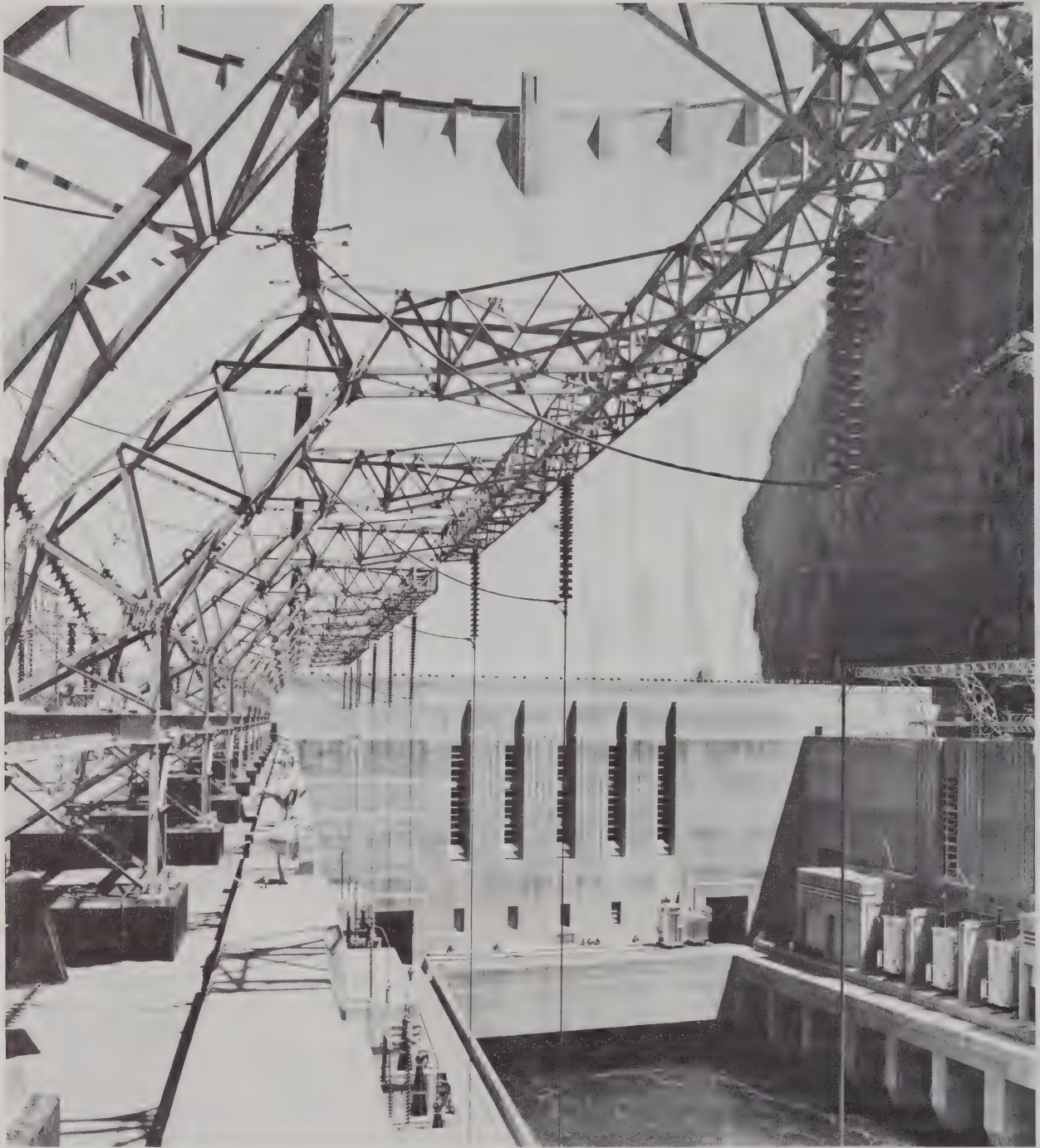
— U. S. Bureau of Reclamation

Power plant at Parker Dam on the Colorado River

While good transportation and communication facilities are vital to a growing economy, a modern community is also dependent upon an ample supply of electric energy, especially for industry and, in Arizona, for pumping underground water for irrigation.

In 1944 the Arizona Legislature passed the Power Authority Act which provided the legal basis for the state to secure and utilize its share of the power from Hoover Dam. The Authority was required to be self-sustaining and was given no funds for operation or for construction of the necessary transmission lines. However, the federal Bureau of Reclamation proved willing to build into Arizona high-tensioned transmission lines within reach of customer taps, and to accept as payment an annual wheeling charge.

These lines have a total mileage of about 1,380 and reach, either directly or by connection with company or project lines, all of the major population centers in the state. This same act required the Authority to prepare a preference list of public bodies such as irrigation districts, electrical districts, cooperatives, and municipalities. Any excess of electricity over and above the needs of customers on the preference list may be sold to corporate electrical producers and distributors. The Authority is not confined to sales of hydroelectric power; it may also purchase and sell steam-generated power. During the year from July 1, 1958, to June 30, 1959, the Authority sold 865,816,690 kilowatt hours of Colorado River power and 197,065,492 kilowatt hours of steam-



— U. S. Bureau of Reclamation

A view of the power plant at Hoover Dam — source of much of Arizona's power

generated power. The Authority does not sell directly to the consumer, but to organizations which distribute it to users.

During the hearings on the Authority bill, responsible and respected individuals in the state testi-

fied that, in their considered judgment, the state would not need all the power and energy from Hoover Dam until possibly 1970. These individuals could not be blamed for not foreseeing the tremendous growth that has taken place in the Southwest.

For, by 1959, Hoover power had long since been fully utilized and so had Arizona's share of power produced by Davis Dam, which was completed in 1951.

The rapidly increasing population, and especially the growing industrialization of Arizona have increased the demand for electrical energy far above the hydroelectric capacity and the generating plants of yesteryear.

In 1941 the Salt River Power District constructed a steam generating plant to augment the power supplied by the dams on the Salt and Verde rivers. But this did not prove adequate. Between 1941 and 1958 power customers increased from 8,000 to 59,455. To keep abreast of the increasing demand, the first unit of the Kyrene steam generating plant, located about four miles southwest of Tempe, was put into service in 1952, and the second unit in 1954. This plant, which cost \$12,383,845, added 90,000 kilowatts to the Project generating capacity. In 1957-58 two units of the Agua Fria Steam Generating Plant were constructed by the District on the outskirts of northwest Phoenix at a cost of \$25,000,000. These units generate 227,272 kilowatts and bring the total generating capacity of the Salt River Project to 428,162 kilowatts.

The Arizona Public Service Company has also found it necessary to expand its facilities several times. In 1950, at a cost of \$15,000,000, it increased the capacity of its Phoenix plant to 145,000 kilowatts. Since then it has constructed the Saguaro plant at Red Rock in 1954-55 to develop 200,000 kilowatts; built the Yucca plant at Yuma in 1957-59 to provide 80,000 kilowatts, and the Ocotillo plant at Tempe to provide 110,000 kilowatts. These plants, together with the other seven smaller plants operated by this company, provide a total generating capacity of 576,115 kilowatts.

The Tucson Gas, Electric Light and Power Company was able to meet the needs of Tucson and environs for many years with the power generated by its combined diesel and steam plants at Sixth Street and at Cortaro. In 1948 it was necessary for this

company to erect its DeMoss-Petrie plant with a capacity of 105,000 kilowatts, and in 1958 it completed its Plant No. 4 on Irvington Road with a capacity of 160,000 kilowatts. In addition, the company has available for distribution 30,000 kilowatts from the Arizona Power Authority.

Besides the large plants discussed above, there are numerous smaller power plants around the state, bringing the total to more than seventy. In 1958 the total production of electrical energy in Arizona was:

<i>Method</i>	<i>Kilowatt Hours</i>
Hydro	4,302,000,000
Steam generation	3,311,000,000
Internal combustion	38,000,000
Total	7,650,000,000

In addition, the Arizona Power Authority was allocated 803,060,000 kilowatt hours from Hoover Dam and about 64 percent of the 2,080,387,591 kilowatt hours generated at the Parker, Davis, and Siphon Drop plants on the Colorado River.

Anticipating the increasing power demands of the future, the Arizona Power Authority has announced plans for the construction of three additional hydroelectric power projects on the Colorado River—the Bridge Canyon Dam, the Prospect Dam, and the Marble Canyon Dam. An estimated \$500,000,000 will be required to carry this program to completion. The private utility companies of the state have announced plans for construction of an almost equal amount of steam-generated capacity; and, the Authority and its power customers, including all publicly-owned and all privately-owned utilities in the state, have jointly offered to contract for the entire power output of Glen Canyon Dam now under construction by the U. S. Bureau of Reclamation on the Colorado River in the northeastern part of the state.

With an assured supply of power for the future, and a dynamic, modern transportation system, the state of Arizona seems to be well prepared for a continuation of the amazing growth in population and industry which has taken place in recent years.

..... *banking and finance*

ONE OF THE BASIC REQUIREMENTS OF A DEVELOPING complex economy is an adequately established and functioning financial system. The satisfactory provision of the essential commodities of money and credit is vital for economic growth and development. Arizona, indeed, affords an excellent example of the significance of financial factors in the state's growing economy.

Arizona's expanding population increases the need for financial services. During the recent period 1950 to 1960, Arizona exhibited the second highest rate of population growth of any state in the nation. In the Rocky Mountain states, Arizona's population is exceeded only by that of Colorado. Between 1950 and 1956, nonagricultural employment in Arizona increased by over 85,000 persons, reflecting a relative growth of about 54 percent. In this same period, Arizona's employment in the finance, insurance, and real estate industry rose from 5,300, to 9,500, a percentage increase of almost 80 percent.

Personal income payments to individuals have also grown significantly in Arizona during the seven-year period 1950-56. Total personal income payments of \$979 million in 1950 rose to \$1,816 million in 1956, a relative increase of over 85 percent. Personal income for the finance, insurance, and real estate grouping increased by about 145 percent between the two dates, expanding from \$18 million in 1950 to \$44 million in 1956.

Arizona's financial institutions have also been very active in financing home construction and real estate ownership. According to data compiled by the Mortgage Department of the American Bankers Association, mortgage holdings by financial institu-

tions in the state of Arizona totaled \$564,645 thousand at year-end 1957, whereas mortgage holdings amounted to \$147,402 thousand on December 31, 1949. Comparing Arizona with the other seven states in the Mountain Region, only Colorado and Utah had larger mortgage holdings as of December 31, 1957.

Present-day financial developments in Arizona reflect the operations of several different groups. It is worthwhile to examine briefly the current standing of the major types of financial institutions operating within the state.

Commercial Banks

The banking industry comprises the most important single group within the state's financial structure. In his annual report for 1957-58, State Superintendent of Banks D. O. Saunders indicated that commercial banks in Arizona held over 79 percent of the combined assets of all banks, savings and loan associations, consumer finance companies, and credit unions in the state. Arizona, midway in 1959, ranked second among the eight Rocky Mountain States in banks' holdings of deposits, capital accounts, and total assets, exceeded only by Colorado.

In addition, on the basis of deposits, the largest and second largest banks in the Rocky Mountain Region are the Valley National Bank of Arizona and the First National Bank of Arizona, respectively. In mid-1959, these two banks ranked forty-fourth and eighty-ninth, respectively, in deposits-size among the banks in the United States.

The existence of a state-wide branch banking law contributes to the active role of Arizona banks



— Bill Sears

Looking south on N. Stone Avenue — the heart of Tucson's financial and banking district

in financing economic development. Currently, seventeen states and the District of Columbia permit state-wide branch banking. These seventeen include the Rocky Mountain states of Arizona, Idaho, Nevada, and Utah. At the end of 1959, five commercial banks in Arizona operated a total of 147 branches, which were located as follows: forty-seven branches in head-office cities, twenty-four branches elsewhere in head-office counties, and seventy-six branches elsewhere in the state. Almost half of the 147 branch offices were located outside of the head-office counties, thus indicating the provision of banking facilities for the smaller towns and communities in the state.

Generally speaking, banks with state-wide branches can participate in greater and more diverse lending activities than can unit banks. State-wide branch banking facilitates the flow of savings funds from urban to rural areas and from relatively more developed areas to relatively less developed areas. In effect, state-wide branch banking provides the

basis for a more economic allocation of banking resources within a state. Indeed, the Arizona branch banking law establishes a legal framework for the development of a viable banking system, well adapted to financing the needs of a rapidly growing state.

Commercial banks in Arizona have been active participants in the state's growth, especially as reflected in the high rate of lending to private borrowers in the form of loans and discounts. Loans and discounts constitute the primary type of output of commercial banks. In each year of the ten-year period from mid-1950 to mid-1959, insured commercial banks in Arizona, as a group, held a higher proportion of their total assets in the form of loans and discounts than did all insured commercial banks in the United States, as a group. Among the Rocky Mountain states, Arizona-insured commercial banks, taken together as a group, exhibited the highest ratio of loans and discounts to total assets in each year of the five-year period from June, 1955, to June, 1959. Since June of 1957, insured commercial banks in

Arizona have held more than half of their total assets in the form of loans and discounts, attaining a new high loan ratio of over 54 percent in mid-1959. As of June 10, 1959, only five states had 50 percent or more of their insured commercial banks' assets in the form of loans and discounts. These five states and their respective loan ratios include: Vermont with 55.5 percent, Arizona with 54.2 percent, Rhode Island with 52.8 percent, Utah with 50.5 percent, and California with 50.3 percent.

Another aspect of the changing structure of banking in Arizona is the increase in the number of bank mergers in recent years. Bank-merger activity in Arizona constitutes a part of the over-all bank-merger movement in the United States. This general merger movement is the principal factor accounting for the gradual reduction in the number of commercial banks in the nation and in Arizona during the post-World War II period. In the five-year period between 1953 and year-end 1958, the total number of commercial banks in Arizona declined from fourteen to eight, while in this same period a total of seven banks with combined banking resources of over \$86 million were absorbed by three banks having head-offices in Phoenix. It should be noted, however, that in this same five-year period, the total number of banking offices (exclusive of banking facilities at government establishments) increased from seventy-one to 137.

Although it is difficult to weigh precisely specific factors operative in a particular bank merger, some of the significant general economic factors contributing to bank mergers include: (1) moves by banks to strengthen market positions through diversified operations, particularly in the growing area of "retail banking"; (2) adaptation to appreciable population shifts into outlying suburban areas through the acquisition of "ready-made" banking facilities, which are often more legally accessible than *de novo* offices; (3) adjustment to the enhanced role of commercial lending which has prompted banks to merge to counteract lagging growth in deposits and business, to expand legally stipulated loan limits, to meet rising competitive pressure of non-bank lenders, and to forestall officer shortages; and (4) attempts to offset the undervaluation of bank shares and to augment financial prestige.

An additional distinguishing characteristic of the banking structure in Arizona is the relative importance of group banking. In simple terms, group banking exists where two or more banks are con-

trolled by a holding company which itself may or may not be a bank. The intrinsic nature of the group banking relationship derives from use of the corporate device to obtain control of banks, whether by direct purchase of stock or by the exchange of holding company stock for the stock of individual banks. Group banking is found in varying degrees in every state in the Rocky Mountain Region. At year-end 1958, the latest date for which data were available, one banking holding company owned or controlled 25 percent or more of the outstanding stock of two banks in Arizona. These two banks had fifty-six branches and total deposits of \$395 million, or, in percentage terms, 40 percent of all commercial bank deposits in the state. As compared with Arizona, banks in holding company groups accounted for a higher proportion of all commercial bank deposits within the following Rocky Mountain states: Nevada, Montana, Utah, and Idaho.

Life Insurance Companies

Life insurance companies have become important institutional investors as individuals have increasingly resorted to life insurance purchases as a form of saving. The Institute of Life Insurance states that life insurance is the principal type of long-term saving for the majority of families in the United States. In return for premium payments by the policyholders, life insurance companies contractually agree to make installment or lump-sum payments to the policyholders when they reach a certain age or upon their disablement, or to their beneficiaries in the event of death of the policyholders. Life insurance companies use premium funds to purchase such obligations as mortgages, and corporate and governmental securities.

Life insurance in force in Arizona has exhibited a large relative growth in recent years. Between year-end 1948 and year-end 1959, life insurance in force in Arizona increased from \$549 million to \$2,490 million, for a percentage gain of over 350 percent. Balanced off against the great growth in life insurance in force in the state is the significant increase in the number of Arizona life insurance companies from three companies at year-end 1950 to eighty-one companies in mid-1958. As of June, 1958, Arizona had the third largest number of life insurance companies in the United States, exceeded only by 323 companies in Texas and Louisiana's 112 companies. At mid-1958 the home offices of twenty-eight life insurance companies were located in the

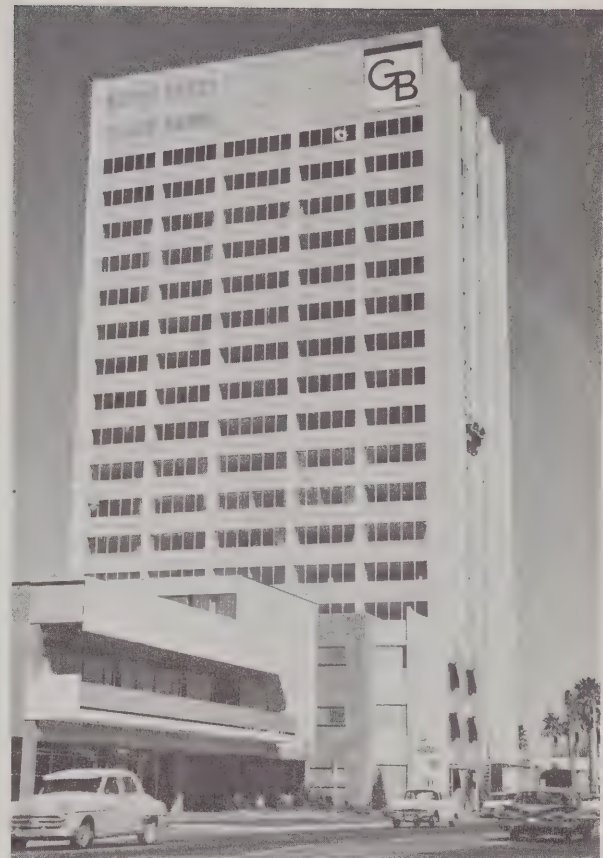
city of Phoenix alone. In addition to domestic companies, over 200 life insurance companies of other states are licensed to do business in the state of Arizona. Within Arizona during the calendar year 1957, the latest year for which data were available, Arizona life insurance companies wrote net premiums totaling over \$30 million, whereas out-of-state life insurance companies wrote net premiums totaling over \$60 million.

Life insurance companies are the major holders of mortgages within the state. At the end of 1957, life insurance companies held a little less than half of the \$565 million in combined mortgage holdings of insured commercial banks, savings and loan associations, and life insurance companies in the state. Mortgage holdings by these life insurance companies in Arizona were distributed as follows: \$34 million in farm mortgages, \$81 million in non-farm FHA and VA insured and guaranteed mortgages, and \$157 million in non-farm conventional mortgages.

Savings and Loan Associations

Another important group within the financial structure of Arizona is that of savings and loan associations. These associations are cooperative thrift groups that are chartered by either federal or state government. Holders of share accounts in savings and loan associations are actually stockholders rather than depositors, and they receive dividends rather than interest on their shares. Savings and loan associations have become increasingly more competitive with commercial banks in recent years especially with regard to attracting savings funds from commercial banks. The associations are generally able to pay a higher rate of return on savings than can commercial banks because the associations hold a high proportion of their assets in long-term, relatively high interest-bearing first mortgages of the conventional type.

Arizona ranks third among the Rocky Mountain states in holdings of total assets by savings and loan associations, being exceeded by the holdings in Colorado and Utah, which are first and second, respectively, among the Mountain States. At year-end 1949, savings and loan associations in Arizona held \$26 million in mortgages; eight years later at year-end 1957, their mortgage holdings totaled over \$165 million. Stated another way, at the end of 1949, savings and loan associations held about 18 percent of the combined mortgage holdings of insured commercial banks, savings and loan associations, and



— Phoenix Chamber of Commerce

The state's newest bank and tallest building — The Guaranty Bank Building, Phoenix

life insurance companies in Arizona; whereas, at the end of 1957, the associations' proportionate holdings of the combined mortgages for the three groups stood at over 29 percent, an increase of over 11 percentage points during the eight-year period.

In mid-1958, nine out of a total of ten savings and loan associations in Arizona were insured by the Federal Savings and Loan Insurance Corporation. All federally chartered associations are required by law to belong to the Corporation, while state-chartered institutions may join if they elect to do so. As of June, 1958, these nine federally insured institutions held over 85 percent of the aggregate assets of all savings and loan associations in Arizona. In June, 1959, the sole non-federally insured savings and loan association was placed in receivership by the state. As a result, the Arizona Legislature at its 1960 session enacted legislation prohibiting the establishment of any savings and loan association until federal insurance is obtained.

..... *real estate*

IN A TECHNICAL SENSE REAL ESTATE AND REAL property are synonymous terms meaning land and all that is attached to it. But in a practical sense, real estate means improvement, development, investment, speculation, brokerage, management, financing, marketing and other activities which occur with increasing frequency in connection with real property as population rises. A population of one and one-third million will support a substantial volume of these activities, but in Arizona, where the population today is more than two and one-half times what it was twenty years ago and is expected to double in the next ten, real estate activity can be expected to reach boom proportions.

Most of this growth has been concentrated in the two major cities, Phoenix and Tucson, although many of the Phoenix satellite communities in Maricopa County and several others in scattered parts of the state—Yuma, Flagstaff, and Casa Grande—have also doubled their populations the last decade.

These are the places in which real estate development has been most pronounced, but speculative interest in Arizona real estate covers the whole of the state from the deserts of the south to the mountains of the north. People from all over the United States have purchased a stake in the glamorous future they foresee for Arizona.

The latest stimulus to Arizona real estate has been the establishment of retirement communities. No statistics are available on all that are planned but there are at least a half dozen well established ones in existence and many more are being launched. The attraction of the state for retirement is more closely associated with lack of humidity than with year-

round mild temperatures, as is the case in Florida and California. For this reason northern Arizona (average elevation over a mile) with low winter temperatures and southern Arizona with high summer temperatures are both able to attract retired people who find humidity rather than temperature the greatest threat to comfortable living.

In the last twenty years, over a third of a million houses and apartments have been constructed in Arizona at a cost considerably in excess of three billion dollars. In addition there have been many billions of dollars spent to provide the commercial facilities, industrial plants, highways, schools, and public buildings needed to service the new residents. Most of this construction has taken place outside of incorporated cities, and thus the figures on building permits do not reveal the extent of the boom in Arizona, since permit procedures are limited largely to incorporated cities. Nevertheless, figures on building permits are quite impressive. In Tucson the value of building permits has more than doubled in ten years and in Phoenix, which is undoubtedly the "boomiest" place between New York and Los Angeles, the permits have more than tripled. The skylines of these two cities reflect this change.

Many of the Phoenix satellite cities also show remarkable increases in building permits, the most dramatic being Scottsdale (the town with the controlled Western look) where construction has climbed from about one-half million dollars in 1952 to well over 10 million. Tempe, which is the home of Arizona State University, has also shown a tremendous increase in the value of new construction during the ten-year period ending January 1, 1960.



— Phoenix Chamber of Commerce

Looking northeast across downtown Phoenix toward famed Camelback Mountain

That phenomenon of intensive urbanization, the regional shopping center, has made its entrance in Phoenix where one has been in operation for a number of years and a second is opening in 1960. In Tucson the first regional shopping center is under construction and is due to open in the fall of 1960.

Although both of Arizona's principal cities were still small, quiet communities in 1912 when the state was admitted to the Union as the forty-eighth state, they are both now large enough and sufficiently developed to be in need of Urban Renewal. Each of them has applied for federal assistance in this respect and will in the near future embark on a program of slum clearance and urban rehabilitation.

Most of Arizona's home building has been done by tract builders who have developed the science of high-quality, low-cost construction to the point where three-bedroom homes with enclosed patios on 8,000 square feet lots are sold for as little as \$8,500.

In Phoenix, John Long, whose company is the largest builder in Arizona and one of the largest in the world, is in the forefront of those making technological advances in the science of home building. Arizona can also boast of the subdivider who has won more awards for his subdivision designs than any other American subdivider and tract builder—Robert Lusk of the Lusk Corporation, builder of many of Tucson's best known subdivisions.

Although the majority of Arizonans live in moderately-priced homes, there are many exclusive subdivisions and magnificent estates for those who can afford them. In fact, Arizona is the place that the newly rich Texan comes to learn to live well without ostentation.

The spectacular views that Arizona topography creates are unparalleled stimuli to architectural imagination. The many unusual custom-built homes in Arizona attest to the challenge of desert and mountain scenery. Where else in America could that su-

preme achitectural artist Frank Lloyd Wright, find a physical environment equal to his imaginative genius? Wright had three homes in the United States but Taliesin West was the one to which he felt most akin and where he died in 1959.

Most Arizonans own their own homes. This has been made possible by the FHA and VA financing provided by many life insurance companies and mutual savings banks located in the northeastern part of the United States. These institutions have shown their great faith in Arizona's future by the amount of money they have made available for home mortgages.

For years Arizona has had relatively few savings and loan associations upon which to depend for home mortgage financing, and the bulk of the local funds made available for this purpose had to be provided by commercial banks. Today, the state can boast of many well-established savings and loan associations with very sizable assets and, as is the case in most places in the United States, they are Arizona's fastest growing financial institutions.

Arizona homes are usually of the ranch style with enclosed patios. This patio is an important part of Arizona life, providing an extra living room during most of the year. Often the patio has a swimming pool, barbecue facilities and paved areas for dancing and partying. Within the house, design and arrangement of the rooms are very similar to those found in ranch houses throughout the United States, but one modification in southern Arizona is the cooling system that is found in almost every house. Until recently this cooling was by the evaporative method, which was inexpensive and, because of the lack of humidity, quite effective. Today more and more homes are being cooled with refrigeration, and the use of typical desert cooling is on the wane.

Mud blocks baked in the sun (adobes) have been the traditional Arizona building material. These blocks, twelve to eighteen inches wide, are grouted with cement or mud into a tapering wall which is covered with chicken wire and plastered. These walls are probably the best insulation known to man, but with the cost of labor ever on the rise there are few who can afford to construct such an adobe house. Today, pumice block, brick, and burnt adobe are the principal Arizona building materials.

Real estate transactions in Arizona are handled with a speed and a dispatch that will amaze most Easterners. When a purchase contract is signed,

the earnest money is placed in escrow and a title policy is ordered immediately. As soon as the title policy is ready, the escrow agent, who may be the title company, a broker, or a lawyer, will make the closing adjustments, draw the papers and have the parties come in at their convenience to sign and to make the remaining payments. The escrow agent then completes the transaction by recording the instruments and paying the sellers the balance due. All this may take place without buyer and seller ever meeting and can be completed in three days if necessary. Many title companies are to be found in both the large cities, and most of them operate on an almost state-wide basis.

Much of the state land (8,000,000 acres in 1958) is held by the state as a trust for the benefit of the public school system. With the great increase in real estate values it is anticipated that a very substantial assist for public education will be produced by the periodic sales of these lands.

Most Indian lands in federal trust in Arizona are owned by the tribes as cooperative units rather than by individual members. Many non-Indians have difficulty in understanding how this form of land-ownership works, but within the Indian groups there is every evidence that it is as satisfying to them as separate and individual ownership is for most of the rest of us. Because Indian cooperative ownership makes possible long-range comprehensive planning of enormous reaches of land, it is anticipated that the Indian reservations will play a very significant role in the future of Arizona real estate.

Arizona's Spanish heritage is revealed in the frequently found separation of mineral rights from surface rights in real estate. The Spanish crown reserved to itself all the minerals in the lands in its colonies and this pattern of reserving the mineral rights has persisted to this day in the practice of the federal and state governments and of private owners. Since minerals abound in Arizona, it is easy to envision the owner of a home in a swank subdivision keeping a pack of mastiffs to drive off the hordes of prospectors seeking to find a rich strike on his lot. But this is only a fantasy since prospecting is not permitted in developed areas. Moreover, most of the minerals in Arizona are not of the "get-rich-quick" variety that the prospector can find with an ordinary pick and haul off on a burro's back, but predominantly of the type that requires large-scale equipment and, to an ever-increasing degree, the latest in modern technological skills and know-how.



— Ray Manley

The Santa Catalinas form a majestic backdrop for Tucson and its suburbs

Another inheritance from Spain of importance in real estate is the community property law which is the basic property system for husbands and wives in Arizona. The essence of the law is that real estate bought out of the earnings of either spouse belongs in equal undivided shares to both. The community property system is one of almost complete equality; the only element of inequality to be found is the right of the husband to manage personal property. In real estate the husband enjoys no preference, and each of the spouses must join in any sale. Community property rights do not extend to property owned by either party before marriage or to property received by inheritance or gift.

Out in the wide stretches of desert a man may do what he will with his land if he has the money to pamper his fancies, and many a wealthy cattle man has indulged himself in his home or his outbuildings. But when individuals live in close proximity no man may do with his land that which will destroy the value of another's, and the enforcement of this principle requires the establishment of planning and zon-

ing legislation and subdivision controls. In the two most populous counties, Maricopa and Pima, there are both municipal and county planning and zoning commissions, and these bodies make strenuous effort to cooperate as closely as possible. In Pima County the planning staff works for both the county and the city of Tucson. This results in the development of consistent goals and facilitates the expansion of the corporate limits of the city.

Many of the other cities in Arizona have established zoning and are now actively developing full scale planning programs to enable them efficiently to handle their land use programs. There is no state planning board or commission to aid these municipalities, but the University of Arizona has established a team of planning experts who are available to provide assistance to the various Arizona communities in need of guidance.

Real estate brokers and salesmen in Arizona are licensed, and their activities are supervised by the State Real Estate Department. The Real Estate Act first passed in 1937 has been periodically

strengthened, most recently in 1960. Most Arizona communities have a well established real estate board affiliated with the National Association of Real Estate Boards, and the vast majority of brokers in Arizona are entitled to call themselves "Realtors," which means they are members of a board affiliated with the national board. In Phoenix the real estate board has established a court which will try disputes between members of the board and the public. It will discipline its members in the event they are found to have violated the Realtors' code of ethics. This court has received national publicity and is the subject of a book by Bryan Schimfessel, the state secretary, entitled *Mirror of Justice*.

There are also chapters of the Mortgage Bankers Association and the Appraisal Institute in the state and chapters of the Society of Residential Appraisers in both Tucson and Phoenix. It thus can be seen that real estate men in Arizona are striving to establish a high standard of business ethics and professional competence.

There is probably no state in which the term "real estate" covers such a wide variety of climates, soil types, agricultural lands, extractive processes, and urban and rural uses. Though much of Arizona is desert and much of it is mountainous, there is very little land that Arizonans will admit cannot be used. Many developments are planned for the next decade.



..... *the forest industries*

THE FORESTS OF ARIZONA NOT ONLY YIELD WOOD for the lumber industry, and are the major watersheds for the state, but they also provide forage for livestock, a home for wildlife, and are major recreational areas for Arizona residents and visitors.

The wood-using industries are based on the trees growing on some 3,180,000 acres of commercial forest land. These forests are composed chiefly of ponderosa pine with smaller amounts of Douglas fir, white fir, Engelmann spruce, aspen, corkbark fir, and Gambel oak. In addition, there are about 16,000,000 acres of non-commercial forests, those which usually do not produce commercial crops of sawlogs, pulpwood, poles, posts, and fuel. Principal trees of the non-commercial forests are several species of piñon pine, junipers, and oaks. These trees are usually slow-growing, small, and of low quality.

In Arizona, as in most of the western United States, the occurrence of forests and of different species of trees is determined chiefly by availability of moisture and by temperature. Precipitation and temperature vary with elevation and thus there is a close relationship between elevation and the kind of forest in any area. The non-commercial forests of piñon, juniper, and oak are found mostly between 5,000 and 7,000 feet where precipitation ranges between twelve and eighteen inches a year. The commercial forests occur above an elevation of 6,000 to 7,000 feet where the range of precipitation is usually from nineteen to thirty inches. Ponderosa pine is the principal species of the commercial forest and reaches its best development between 7,000 and 8,000 feet. Starting about 7,500 feet, Douglas fir becomes important, while above 9,000 feet Engel-

mann spruce and corkbark are important. Aspen occurs in patches or groups throughout the forest.

The federal government owns 69 percent of the commercial forest land in Arizona, while the Indian tribes own another 26 percent. The wood-using industries are dependent chiefly on wood produced on the eight national forests and on several Indian reservations, notably the Navajo, San Carlos Apache, and Fort Apache reservations. Only 4 percent of the commercial forest land in the state is privately owned. Commercial timber on lands owned by ranchers or other private owners is an important source of added income for this group. These owners also receive value from sawlogs, fence posts, poles, fuel, and other products used at home.

If all the sawtimber — live trees of commercial species big enough to cut — standing in Arizona's commercial forests were cut, it would make enough lumber to fill a train of boxcars 6,838 miles long. The distribution by species of sawtimber and growing stock is shown in Table I. The ponderosa pine forest extending through central Arizona into New Mexico is the largest continuous ponderosa forest in the world.

More than 99 percent of the annual timber harvest in Arizona is manufactured into lumber and construction timber. The earliest record of lumber production in the state is for 1869, when 1,200,000 board feet were cut, equal to about a single day's production today. As the population of the Southwest grew, Arizona lumber production grew with it. Payrolls in the lumber industry for loggers and millworkers amount to about \$12,000,000 every year. Employment of labor, investment in equipment and

TABLE I
The Volume of Timber in Arizona Commercial Forests

	<i>Sawtimber</i>		<i>Growing Stock</i>	
	<i>Million Board Feet</i>	<i>Percent of Total</i>	<i>Million Cubic Feet</i>	<i>Percent of Total</i>
Ponderosa pine	17,534	87.7	3,100	83.8
Douglas fir	1,449	7.3	335	9.0
White fir	454	2.3	110	3.0
Engelmann and blue spruces	181	0.9	45	1.2
Other softwoods	199	1.0	34	0.9
Total softwoods	19,817	99.2	3,624	97.9
Hardwoods (broadleaves)	171	0.8	76	2.1
Total all Species	19,988	100.0	3,700	100.0

manufacturing plants, and outlay for services in harvesting and processing the forest crop represent only a part of the new wealth brought to Arizona by the lumber industry. Labor and facilities used in moving Arizona lumber to the market bring still more income into the state.

The wood-using industries—those which manufacture lumber, millwork, pulp and paper, furniture, containers, excelsior, and other wood products—also make an important contribution to Arizona's economy. There are over 140 establishments in Arizona that depend on wood as a raw material. These plants provide employment for over 3,000 persons. In a single year the wood-dependent industries contribute more than \$30 million to the wealth of Arizona through their payrolls, value added by manufacture, and through capital expenditures to improve plants and facilities.

Nearly 90 percent of Arizona's lumber output is shipped to market in other states. Michigan, Ohio, and Texas are leading customers. Ponderosa pine is a favorite for a multitude of uses in these markets because it is soft, uniform in texture and workability, and has a warm, pleasing appearance. Ponderosa pine is used more than any other wood for millwork, including windows, sash, frames, cabinets, and similar articles.

Considerable attention is being paid currently to the establishment of a pulp and paper industry in Arizona. Several years ago a pulp mill was constructed in Flagstaff. Such plants are needed to utilize more completely the trees now cut for lum-

ber and to serve as a market for trees smaller than sawtimber size. Since many people equate the pulp paper industry with areas having large, permanently-flowing rivers, the question is often asked where the water will come from to supply these mills in Arizona. The answer is that hydrological studies indicate sufficient reserves of underground water to meet the requirements of the industry. The United States Forest Service recently sold six million cords of pulpwood for a pulp mill which is now under construction near Snowflake. The Navajo Tribe has established the Navajo Forest Products Industry to utilize the large stands of timber on the reservation and to construct a pulp mill near Window Rock. A study has also been made for the location of a veneer, plywood and wood-treating industry.

Arizona is one of forty-five states in which there is an industry-operated American Tree Farm system. The system was started by the industries in 1953, under the sponsorship of the Western Pine Association. The purpose of the Tree Farm program is to encourage private forest owners to protect and manage their properties for continuous production of tree crops and other benefits. Foresters of the Western Pine Association certify new Tree Farms and at regular intervals reinspect certified units to insure maintenance of high standards of forest management. In October, 1957, there were 70,243 areas of privately-owned forest land in certified Tree Farms in Arizona.

Arizona's forests yield products and provide services of great value other than wood. The man-



— Pete Balestrero

Southwest Lumber Mills' sawmill at McNary in the White Mountains of eastern Arizona

agement of forests for more than one product or service at a time is called multiple-use management. Most of Arizona's forests are now run on a multiple-use basis.

In much of the western United States, and particularly in Arizona, water is probably the most important single product of the forests. It is the life-blood of the cities with their industries, and of the state's great agricultural enterprise. Such crops as cotton, citrus, and vegetables require much more water than the average of eight inches falling annually on the agricultural areas. Most of this water comes from the forest-clad mountains and plateaus.

The high elevation spruce-fir-aspen forest is estimated to yield 30 percent of the total precipitation

as streamflow, the intermediate ponderosa pine forest 16 percent, and the low-elevation piñon-juniper forest about 4 percent. A knowledge of the relationships is important in the management of watersheds for increased water yields.

Since Arizona is currently using practically all of its surface waters, and since groundwater levels in many areas are being steadily lowered by pumping, the citizens of the state are concerned about the future. In 1956, the Arizona Water Resources Committee was formed. Experts in watershed management were brought in by the committee to summarize existing research results and to give opinions. As a result, a program of watershed management has developed, and a Department of Watershed Manage-



—Valdis Photos

Hauling Arizona ponderosa pine logs to the mill

ment has been established in the State Land Office. The watershed management program of this department has placed emphasis on modification of existing forest management practices to obtain greater water yields. A greatly expanded watershed management research program has developed, and larger "pilot plant" tests of the effect of vegetation modification on water yields begun.

The forests of Arizona also figure prominently in the recreation business of the state. It is estimated that there are about 10,000,000 visitors to the forests of the state each year for sport and recreation. The millions of dollars these people spend in their visits make an important contribution to the income of the state. With a growing population, increasing urbanization, and more leisure time, the recreational pressure on forests is expected to increase greatly. Management plans for the national forests are being modified to meet these needs, and within the past ten years lumber industry leaders and the Indian tribes have recognized recreation as an important product of their forest lands.

The grasses and other forage plants of the forest and woodland areas of Arizona are the basis of an important segment of the state's livestock industry. Yields of grasses, like trees, increase with increasing precipitation, so the areas where forests exist can produce relatively high grass yields. Currently,

much effort is being expended in clearing non-commercial forest areas of juniper and piñon to increase livestock carrying capacities.

The forests also provide the homes, food, and protection for large numbers of wild animals. Arizona ranks among the top fifteen states in its big game population—principally deer, elk, and antelope. About 100,000 hunters each year pay over a half million dollars in license fees to pursue their sport in Arizona. Most of the stream fishing is also found in the forested areas. It is estimated that hunters and fishermen spend about \$43 million annually within the state.

Arizona has the distinction of having developed the first forest research program in America. In 1908, the Forest Service of the U. S. Department of Agriculture launched its research program in forest management with the establishment of the Fort Valley Experimental Forest near Flagstaff. This station, now the oldest in the United States, has devoted its efforts to research in better management of ponderosa pine in the Southwest. Other research centers maintained by the Forest Service are located at Tucson and at Tempe. The Tempe center is devoted to the various aspects of watershed management problems. All three Forest Service stations are a part of the Rocky Mountain Forest and Range Experiment Station with headquarters at Fort Col-



—Valdis Photos

Major part of world's largest continuous ponderosa pine forest is in Arizona

lins, Colorado, and are operated in cooperation with the University of Arizona Agricultural Experiment Station which, independently, is also conducting forestry research.

The recent growth of Arizona has served to focus attention on the need for educational programs at the college level. To meet this need, in 1958 the Board of Regents authorized the development of a Department of Forestry at the Arizona State College at Flagstaff, and the creation of a Department of Watershed Management at the University of Arizona.

The future of the lumber industry in Arizona is dependent upon continued and increasing productivity of the forest land, and upon forward-looking management of the industry. The surging population increases in Arizona and the nation seem to assure a steady market for lumber and timbers, and a greatly increased market for pulp and paper products, and veneer and plywood. Forests are a self-

renewing resource, and the increasing interest in forestry evidenced by the wood-using industries and other private landowners in the past two decades, plus continued good management of public forests, gives assurance of adequate supplies of wood for the future. Arizona, fortunate in that its forests were not destroyed by clearcutting and burning in earlier years, now is in a position to build a sound and lasting timber economy based on the fairly well balanced, producing forest now in existence. Despite insufficient knowledge of the desires of people who use and benefit from forests, and of the many complex inter-relationships among forests, people, water, grazing lands and wildlife, Arizona is having to make many decisions concerning her forests and forest lands. The recent intensification of research and education in these areas should clarify and simplify such decisions. Thus Arizona's forests, under proper conservation practices, should be permanent assets.



..... *its cultural institutions*

*The great law of culture is: Let each become
all that he was created capable of being.*

THOMAS CARLYLE

..... *fine arts and literature*

THE ARID LANDS OF ARIZONA WERE A RUGGED environment in the early days for cultural institutions as for all growing things. In pioneer soil the seeds of culture in its various forms germinated, frequently with a struggle, and at times lay dormant from aridity or died from neglect by men and women wholly absorbed in survival and the conquest of the frontier.

Conquest achieved and the basic needs of life supplied, however, the ultimately favorable climate of Arizona and the nurturing of many talents have brought the fruits of culture to a time of harvest.

The fine arts—painting, sculpture, architecture, music, drama, and literature—have developed in Arizona against odds. They are a slow-moving hybrid of varying ethnic strains; native fruits excitingly tinged with cosmopolitan flavor and mellowed with Southwestern history. They are a delight alike to today's Arizonans who have the leisure to enjoy them and contribute to their continued growth, and to today's visitors to the state who are constantly enriching the harvest.

Art

Art is more than a thousand years old in Arizona, but renews itself every day with the influx of new people and new ideas into the state. The Southwest sheltered the northernmost of the great Indian cultures, and art of anthropological and ethnological interest was contributed here in quantity, occasionally rising to a level of aesthetic excellence.

In modern times, the Indian artist has been placed in a difficult position by the clash of cultures he has endured. Today, however, he is beginning to



—Tad Nichols

Navajo Indian woman weaving a rug

see his way toward a means of expression taking cognizance of the facts of modern life. Satisfying blends of Indian tradition and contemporary styling have been achieved. Among outstanding artists of Arizona tribes are the Navajo painters Harrison Begay, Beatin Yazz, and Andy Tsinajinie; and Fred Kobotie, a Hopi. Able artisans and craftsmen are



"Navajo Woman on a Horse" by Navajo painter Gerald Nailor



"Los Niños," by Ted de Grazia. Chosen for UN Children's Fund Christmas card

also contributing abundantly to Arizona's treasury of contemporary art. Hopi silversmiths Charles Loloma and Paul Saufkie, and Kenny Begay, Alan Kee, and Tom Bahe from the Navajo tribe are all distinguished. Carrying on the great tradition of Indian crafts are such potters as Fanny and Elva Nampeyo, Charles Loloma and his wife Otelie, and Faye Avachoya, all Hopis; Sam Begay, a Navajo outstanding in sand casting silver; Otto Penewa, a Hopi maker of Kachima dolls; and Tommy Yazzie, a Navajo expert in figure carving. The art of weaving is being continued, although in this field names of individuals are not so familiar.

Spain contributed a part of the rich heritage of art to the Southwest, and again, Arizona was a northern outpost. The missions established by Spain are interesting not only for their history and architecture, but also for the painting and sculpture in them, relating them to age-old Iberian traditions. At San Xavier del Bac south of Tucson, the finest of such missions houses works of art whose sophisticated and folk traditions reveal relationships to the Gothic, Baroque, and Churrigueresque styles of Spain and Mexico.

Considering the bond of Arizona with the Latin traditions of the past, it seems fitting that the Fine Arts Gallery at the University of Arizona in 1960 became the home of a great Spanish work of art from the sixteenth century, the Retablo of Ciudad Rodrigo by Fernando Gallego. Twenty-six paintings form this largest and finest representation of the Hispano-Flemish School of painting outside of Spain.

The Samuel H. Kress Foundation presented them to the University.

During the pioneer period of Arizona's settlement, art at times seemed conspicuous by its absence. Difficulties of survival, perhaps even the very magnitude and rugged character of the desert and mountain environment discouraged the development of art. With settlement accomplished, however, life in the desert revealed attractions, and artists began to come to Arizona from many other places. Within the last three or four decades, Arizona has been the home of many well-known artists—the late Hutton Webster, Jay Datus, the late Maynard Dixon, Edith Hamlin, Stanford Stevens, to name just a few. These people have painted in Arizona, and all at one time or another painted of Arizona, although their palettes are wider than the state and their talents varied enough for a multitude of subjects. Tucson artist Ted de Grazia was recently honored by the selection of his painting "Los Niños" as a Christmas card for sale by the United Nations Educational, Scientific and Cultural Organization.

Artists formerly lived and worked in Arizona in a spontaneous individualistic milieu, for until the last two decades there were almost no shows and until the last decade no real galleries. There were, however, small informal organizations, such as Tucson's Palette and Brush Club, to which many excellent artists belonged.

The state's most important collections are now in the possession of the two universities. Arizona State University has a collection of 149 paintings, sculptures, and prints, mostly American, given by Oliver B. James in 1950. There are also twelve paintings in the Ruskin Collection of works attributed to Renaissance and Baroque masters. The Heard Museum in Phoenix has fine displays of the traditional Indian arts, as have also the Arizona State Museum in Tucson, the Museum of Northern Arizona in Flagstaff, and the Amerind Foundation near Dragoon.

In 1945, the University of Arizona at Tucson received the Charles Leonard Pfeiffer Collection of 104 American paintings. In 1949, Oliver James added five items of importance. In 1951, the Samuel H. Kress Foundation gave the University twenty-six works of Renaissance art, the most important single collection in the Southwest, and in 1955, the Samuel Lotta Kingan bequest of 100 paintings and *objets d'art* was added. The Gallery in the Fine Arts Center opened in 1956, housing all of these, as well as



“The Last Judgment” — panel from Gallego’s *Retablo of Ciudad Rodrigo* in U of A Kress Collection



— Stuart Weiner

Oil on copper landscape attributed to Rembrandt — Phoenix Art Museum collection

the Edward Joseph Gallagher III Memorial Collection of 100 works of modern art. In 1958, Mr. James P. Gordon contributed eighty paintings by younger Americans, and the Gallego Retablo was given to the University of Arizona in 1960, its Seventy-Fifth Anniversary year.

Civic art events are growing in the two major cities and activity is spreading to other areas in the state as well. The Phoenix Art Museum in the Civic Center opened in 1959 with a permanent collection valued at three-quarters of a million dollars including Renaissance, nineteenth century, and modern European painting. The Tucson Fine Arts' Association has run a full program of local, state, and interstate competitions since 1948, and brings touring shows. The Verde Valley Artists maintain a gallery at Jerome, sponsoring exhibits and festivals, and a growing art colony at Sedona suggests the possibility that the fine arts might flourish in the mountain country of northern Arizona, as they have in the wooded hills of New England and New York, and at Aspen, Colorado.

Prescott and Douglas have active art collections.

To indicate the interest in art among residents of Arizona towns is this example—in June 1960, thirty-seven residents of Douglas, Bisbee, and Warren received daily instruction in art history and painting from a member of the University of Arizona extension staff teaching in Douglas. The state and county fairs of Arizona have now installed art sections which are heavily subscribed and well attended. The Arizona State Fair at Phoenix has an especially important show.

Among craftsmen, the accomplished Indian peoples are continuing their work, and other groups are strengthening. The artisans and craftsmen of Scottsdale near Phoenix have developed a notable center since 1945, and a loosely-knit organization called the Arizona Craft Council. In Tucson, the Craft Guild is associated with the Fine Arts' Association. This year a new group, the Arizona Designer-Craftsmen, was organized.

The scenic drama of Arizona has fostered the development of photography as an art. The technical excellence of the modern camera, and the science and skill of the modern cameraman could scarcely be



— Esther Henderson

“Reflections” — tranquil beauty captured on film by one of Arizona’s famed photographers



— Esther Henderson

The artistry of the camera catches the beauty of winter in Arizona

more at home than in Arizona where subject matter ranges from aspen forests and blue lakes to saguaro-studded deserts, all treated seasonably to a marvelously varied play of light and shadow. Through *Arizona Highways* magazine and national publications featuring Arizona's pictorial beauty, the scenic wealth of the state has come to belong to the world. Many of the pictures in this volume testify to the skill of Arizona photographers.

Arizona's individual photographers, professional and amateur, rank high in ability and have exhibited nationally, winning prizes and gaining prominence through magazines and newspapers. Many of these photographers have had all their training in the state, often beginning in school photography courses.

As the state's contemporary interest in art grows apace, all such interests are being fostered by the universities and colleges of Arizona. Art has been a part of the curricula since the founding of these institutions. Today, degrees are offered on graduate and undergraduate levels, and enrollments total well

over 2,000 in studio courses, history of art, and art education.

Because the Arizona environment is many-faceted—plateau, mountain, desert, and now teeming city as well—because the state's history is complex, and its population woven of various strands, the art of Arizona cannot be summarized as regional, parochial, or provincial. The inspiration of local qualities is strong and everpresent, but the art and artists, like Arizona itself, are many-sided, and bound in many ways to traditions of art all over the world.

Architecture

Architecture, perhaps more than the other fine arts, reflects the culture and the progress of the people, and this concept is nowhere more clearly illustrated than in Arizona. The state has had phenomenal growth in population—71 percent since 1950—with rapid urbanization of its cities, and predictions abounding that Phoenix and Tucson will some day be among the largest cities in the nation.



— Frank Mannarino

Modern architecture in Arizona — Taliesin West (left) and Mayer-Central Building in Phoenix

Hand in hand with this progress has been the rate of Arizona's building—proportionately greater than in almost any other section of the country, and still accelerating.

This growth, of course, brings both blessings and disappointment, more noticeable in metropolitan areas than elsewhere. Both Phoenix and Tucson now boast modest skyscrapers, fresh and clean in design, sturdy in structure, efficient in operation, and reflective of the steadily advancing position of the architectural profession in the state. Many people feel, however, that the newer buildings have taken a toll of the older architecture with its rich historical significance. This becomes a problem in Tucson, for example, when large sections of the older city are removed for rehabilitation in an urban renewal program.

Arizona and the Southwest, like other regions of the United States, have a special stylistic architecture, although perhaps somewhat less well-known than that of New England or the Mississippi delta. During the present active period of expansion in population and construction, Arizona architects are frequently reminded to keep this tradition in sight and not to bury it in a structural style without regional roots. This does not argue that only Spanish or Territorial architecture is appropriate for Arizona, but that the state does have a virile tradition of distinction which in its own design takes cognizance of temperature, sun, and nature of the arid regions. The maintenance of this tradition is of importance both to the old resident and the visitor, who loves to come to Arizona not only for sunshine, but for a look at its colorful past.

A comparison of the Arizona residence of the late Frank Lloyd Wright—Taliesin West near

Phoenix—with his Wisconsin home points up the distinctiveness in contemporary architectural style. Wright's controversial design for an Arizona State Capital goes even deeper—reflecting appropriateness of certain specialized design concepts for the arid region only.

With respect to Arizona history, frontier architecture of Arizona ghost towns in mining areas, the Territorial design, and the Spanish missions such as San Xavier are all important resources for modern architects. They are all used at times by modern designers to develop a valid "technology," that is, a happy marriage of regionalism and technology to serve the area best.

Phoenix, a city planned and built in modern times, does not have an architectural heritage such as Tucson's, where many monuments relate to an historic style and heritage. But there are in Phoenix excellent tributes to this heritage, such as the Heard Museum, widely recognized as one of the finest modern examples of Spanish architecture in the Southwest. Design devices drawn from the past and useful in the present—for example, walks shaded by the over-arching buildings—are evident in the Chandler area near Phoenix.

On the contemporary scene there are examples in both Phoenix and Tucson to show that these cities are keeping pace. Among these are the highrise office building in Phoenix by Tucsonan Nick Sakellar and the Tucson structure, the Kitt Peak National Observatory by William Varney of Phoenix. The Pima Building in Tucson, and indeed a number of small commercial buildings in both cities reflect progressive design.

On the other side of the stylistic picture are many fine structures blending a full measure of contem-



— Frank Mannarino

Southern Arizona Bank Building, Tucson

porary technology and traditional flavor. A few examples include the two most recently-built branches of the Bank of Douglas in Tucson, and the Casas Adobes and Broadway Village shopping centers, both by Gordon Luepke. The Southern Arizona Bank in Tucson by Lew Place has been controversial, stylistically speaking, but has fitted itself easily and decoratively into the city pattern.

The churches of a city are perhaps among the most readily visible of its architectural adornments. Phoenix and Tucson both abound in churches, and here again the traditions of Arizona and the contemporary vision are both strongly represented. Among those notable for clean-cut functional quality and basic respect for the materials used are All Saints' Episcopal Church in Phoenix, a winner of national awards; First Christian, Trinity Presbyterian, and Faith Lutheran churches in Tucson (the latter perhaps the most radically contemporary of any in that city; and also in Tucson the Lutheran Church of Christ and the new Temple Emanu-El.

There are many examples of worthy adaptation of traditional church styles in both cities, most of them in a somewhat modified Spanish mission vein, such as St. Phillip's in the Hills, St. Michael and All Angels, Mountain View Presbyterian, and St. Augustine's Cathedral in Tucson. And there are also highly individualized spots of architectural interest such as the little chapel built by Ted de Grazia, Tucson artist, high in the Catalina foothills.

The problem within the design professions as to whether regionalism or technology should dominate is not answerable in black or white, in Arizona any more than in other regions. The trend of architecture today is for more humanism and organic quality, as is easily visible in the newer skyscrapers of Manhattan



— Frank Mannarino

San Xavier del Bac near Tucson

and in the industrial parks of larger metropolitan areas. In regions such as Arizona, where a local tradition can be used to soften the rigidity of some design concepts, this is found to be desirable, and also to foster the growth of the architectural profession locally, because local architects are so much more familiar than their imported colleagues with the details of the regional heritage.

This factor is especially significant in a booming architectural picture such as Arizona now provides. In the cities of the state the status of the architectural profession is being raised substantially. More and more of the major work is being done by local architects; fewer and fewer large projects are going to out-of-state firms. This gives prestige to local members of the profession and acts as well to preserve some of the spirit and tradition of the state.

Education for the practice of architecture has recently started in both major Arizona institutions of higher education. An older course at Arizona State University has been reorganized to meet professional standards, but continues also as a training program towards entrance into the construction in-

dustry. The University of Arizona began its professional course in the fall of 1958 with strong emphasis on design. Both schools are flourishing and their influence on the profession is already felt in the Southwest. At the University of Arizona, considerable emphasis is placed on the architectural problems of arid regions and the possibilities of solar energy as it may influence design for the future.

Taliesin West with its architectural classes at Phoenix not only provides a point of strong contemporary interest for all students of architecture in the state, but is an educative force influencing students from Arizona and elsewhere to an imaginative and far-ranging view of their art.

Professional architectural groups are active in Arizona, not only for experimental architecture concerned with advanced technology, but also in the preservation of historic architecture. Civic design committees work prominently with developmental problems for the metropolitan areas and fast-growing smaller communities. Architects in Arizona are deeply concerned with urban redevelopment programs and assist in the planning of large projects. Not a little effort is being made to assist governmental units and retail merchants in reorganizing the central business districts, to return to them a distinctive quality of merchandising while at the same time creating appropriately progressive shopping centers for the Southwest.

The future of the profession in Arizona is very bright. The state is expanding at such a rapid rate that the demand for architectural service is far in excess of the amount of skill available. The problem of meeting this deficiency is assigned to the universities of the state, which will soon be producing qualified graduates to bridge the gap.

Music

In the last half-century Arizona has developed a notable musical life. The slow, sound growth to this stage was preceded by a period of struggle. Over the fifty-year period, the history of music in Arizona has been one of creative change, reflecting the work of dedicated citizens, community groups, schools, colleges and universities of the state.

The greatest concentration of musical activities has naturally occurred in the metropolitan centers of Phoenix and Tucson. Both communities have long had symphony orchestras, civic choral groups, and concert series which are sponsored by music clubs and by both of the state's universities.

Musical activities at the University of Arizona began as early as 1903. Since that time, growth in the curricula and number of performing organizations has been continuous. The School of Music sponsors a University Symphony Orchestra, Symphonic and Marching Band, Symphonic Choir, Choral Society, Opera Workshop, Faculty Woodwind Quintet, and Faculty String Ensemble. All of these organizations have brought excellent guest performers to Tucson, and members of these groups have appeared in various communities throughout the state.

The University Artist Series Concerts, established in 1927-28, annually draws not only members of the faculty and student body but townspeople as well to the auditorium on campus to hear concerts by world-renowned instrumentalists and singers. Nathan Milstein, violinist, and George London, Metropolitan Opera Company baritone, were among the performers heard in Tucson during 1960.

Students from the School of Music join with the Department of Drama annually to present a full-scale musical production such as "Carousel," the selection for 1959-60.

Beyond the campus, Tucson is a musically busy community. The Tucson Symphony Orchestra of over eighty-five members gives a series of annual concerts from the classical and modern repertoire. These events often are highlighted by the presence of a distinguished star, for example, Leopold Stokowski, who appeared as guest conductor, and violinist Ruggiero Ricci, who was also a performing guest of the Symphony during the Seventy-Fifth Anniversary year. The Symphony also presents a series of children's concerts annually, for boys and girls of the Tucson Public Schools.

The orchestra was founded in 1928 largely through the efforts of the late Harry Juliani, Tucson attorney; the late Dr. John Mez, professor of history at the University of Arizona; and Camil Van Hulse, composer, organist, and first conductor of the Symphony. These men played chamber music together in their homes and engaged in a number of other musical activities leading to the eventual establishment of the Symphony as a performing group.

The Saturday Morning Musical Club, organized in 1907, under the leadership of the late Madeleine Heinemann (Mrs. Harry Berger) built the Temple of Music and Art and within its walls has annually presented concerts by the world's great performers, by local artists, and civic organizations. The Club has

also provided scholarships to finance advanced musical studies for many promising young Tucsonans.

Among other civic groups, the Tucson Civic Chorus, Tucson Boys' Choir, and other vocal groups have enriched the community with numerous choral activities. The Boys' Choir in particular has toured the nation, sung on the steps of the Capitol, concertized in Europe, and during 1960 appeared at various points in the South Pacific area, climaxing its tour in Australia.

The Tucson Festival Society sponsors appearances by nationally known artists and musical groups—often a great symphony orchestra, such as those of Cleveland (in 1960), Boston, New York, and Philadelphia—and presents activities emphasizing Arizona's heritage of Indian and Spanish-American cultures. Among these are the San Xavier Fiesta and the Fiesta of La Placita. At each of these springtime events, the songs, dances, and customs of the Indian and Mexican people highlight a colorful revival of Arizona's cultural past.

An outstanding annual series of chamber music recitals was established in Tucson in 1948 under the leadership of Arthur Lanyon Blair and other leading members of the Tucson community. From four to six such programs are heard annually in Crowder Hall at the Fine Arts Center on the campus given by such ensembles as the Budapest Quartet, the New York Woodwind Quintet, and the Pro Musica.

Metropolitan Phoenix is the other main center of musical activity in Arizona, with a number of active, organized groups. The Phoenix Symphony Orchestra has been in existence for over thirty years, having been established by leading citizens, including Albert R. Etzweiler, Carl Hoyer, and Mrs. Norma Townsend. The Phoenix Orpheus Club, a non-professional male chorus, has given outstanding performances in the state and was highly praised on a European tour. The Phoenix Light Opera Association annually performs several of the best works in this genre.

For many years Mrs. Archer Linde of Phoenix has sponsored a concert series by top-ranking soloists and musical groups. On the campus of Arizona State University at Tempe there is also an Artist-Concert series, as well as a schedule of performances by soloists and ensembles from the university student body and faculty.

Musical activities in northern Arizona center on the campus of Arizona State College at Flagstaff. The Shrine of the Ages Choir has achieved a na-

tional reputation for singing at the Easter Sunrise Service at Grand Canyon. The Northern Arizona Symphony draws personnel from the college, the community, and from neighboring towns.

A state unit of the Music Educator's National Conference, the Arizona Music Educator's Association with 500 members has been an influential force in developing the music program in the elementary and secondary schools of the state. State conferences held each year by this organization offer an excellent opportunity for continuing education, since the various sessions feature outstanding music educators and new teaching aids. The Arizona Music Teachers Association, an affiliate of the Music Teachers National Association, is an organization of private teachers working to maintain and improve standards, ethics and rapport among its members.

The Society of Arizona Composers, founded in 1931, has been active in developing interest in the works of Arizona composers. It has fostered performances of their works in the various communities of the state. Among its members are a number of composers who have received statewide and national recognition. These include Camil Van Hulse, Robert McBride, Henry Johnson, Wendell Rider, Warren Wirtz, Grant Fletcher, Andrew Buchhauser, the late Gail Ridgeway Brown, and Joseph P. Lewis.

The American Guild of Organists has two chapters in the state: the Southern Arizona chapter in Tucson and the Central Arizona chapter in Phoenix. The purposes of the Guild are to advance the cause of worthy religious music and to raise the standards of efficiency of organists and choirmasters by examinations. These chapters annually present organ recitals by artists of international reputation as well as by their own members. The Guild sponsors competitions for the creation of new anthems and organ compositions. It has considerable influence in connection with the standardization of organ consoles and cooperates with church architects and builders in making practical suggestions in regard to organ placement and desirable acoustics.

Until the end of World War II, Arizona had only two or three organs suitable for recital use. Since that time, however, with the construction of new church buildings and remodelling of older facilities, a number of fine instruments have been installed in both Phoenix and Tucson.

Musical activities in the many smaller communities within the state are centered in the local units of the National Federation of Music Clubs. These

civic groups have contributed immeasurably to the growth of interest in music and to its performance. The Federation sponsors contests and auditions to find and foster outstanding young singers and instrumentalists who compete with other Arizona winners for national recognition.

The only really indigenous music of Arizona is that of the various Indian tribes. In a limited sense this music has influenced modern American composition, as in the case of the late Frederick Jacobi, whose *String Quartet on Indian Themes* and *Indian Dances* shows the influence of Pueblo music from New Mexico and Arizona.

To a much greater extent, folk music from across the border has influenced Arizona's musical life. There have been many excellent works based on Mexican themes. Notable among them is Robert McBride's *Mexican Rhapsody*. *The Second Mexican Rhapsody* by this composer will be premiered as a feature of the University of Arizona's Seventy-Fifth Anniversary celebration.

Apart from its influence on American music, Mexican music itself is widely heard in Arizona on radio, phonograph records, and from the Mariachis, the strolling instrumentalists and singers who play and sing *ranchero* music at many of Arizona's gayest fiestas. The rhythms and melodies of Mexico are an everpresent part of Arizona's cultural heritage, dear to residents of the state and transported far and wide in the memories of visitors to the Southwest.

Theater

Like many other western states, Arizona owes its theater heritage to the mining camps. Students of the theater are always surprised to discover the rich bill of theatrical fare that was offered miners of the Arizona Territory. Long before substantial theater buildings were erected in Tombstone, Tucson, and Prescott, the drama had been brought to the desert and wooded areas of Arizona. From across the eastern plains and from the California Gold Coast, the most enterprising thespians and musicians of the day came to offer their art. They brought not only "entertainment and the sensational" but also the finest aesthetic performances of the era.

The dramatic entertainment usually reflected the spirit of the mining camps and of the times. The strands of Arizona theater were bound together by common needs in the rough and ready environment of the frontier. Transportation and housing were major problems, solved by the use of saloons, town

halls, barns, mining shacks, lecture halls, and outdoor theaters.

First established in the Territory was the Theater Comique, opened in Tombstone in 1879, and owned by Joe Bignon. In 1881, Schieffelin Hall, also in Tombstone, was established and became one of the most popular Arizona playhouses, a home for more or less legitimate drama, and the center of the cultural activity of the mining town. The same year, William J. Hutchinson purchased a property site in Tombstone designated as Lot 9, Block 5, on Allen Street near Sixth, in order to build a variety theater which gained great renown as the Bird Cage Theater. Here, unlike the fare of Schieffelin Hall, the variety-revue type of entertainment was presented.

In Tucson, La Concordia on South Meyer Street—long the only established theater—staged performances by Mexican traveling troupes. Later came the Elysian Grove, the Park Theater, and the Opera House to house many Tucson stock and professional companies.

The earliest settlers brought entertainment of various sorts in the Territory. In Patagonia and south, the medicine man and his wagon moved from township to township. Usually a Mexican troubador accompanied the glib talker, whose main interest was selling ointments, salves, tonics, and lightning rods. The Mormons brought with them the songs and poems of the plains. Religious pageants of many faiths were held in every major hamlet of the Territory, and added to these were the ritual dances and festivals of the native Indian tribes.

For two decades, the traveling performers presented their dramas, dances, and music to inhabitants of the mining camps and nearby towns. In 1903, a literary society of the University of Arizona began dramatic activities for the amateur. The following year the Drama Club was organized on the campus. Interest in theatricals flourished in communities and on campuses and between 1910 and 1924 many drama groups were organized in the state.

In 1910, the University of Arizona granted credit in drama for the first time. The curriculum soon expanded and with this growth came the vital promotion of the "Little Theater Movement," in Tucson and other cities of the state. The necessity for a laboratory theater became apparent, and the Player's Theater, with quarters underneath the University stadium, was inaugurated. In 1937 the University Players were given a more suitable theater in the converted campus gymnasium, Herring Hall.

The Phoenix Little Theatre was organized in 1921. In 1923 the group received as a gift from the Dwight B. Heard family the old family carriage house which was opened as a theatre in 1924. The drama group has been continuously active and moved into its present headquarters in the Civic Center in 1951, opening with *Once in a Lifetime*.

Drama clubs, Little Theater groups, college theaters, and high-school drama departments were organized about the state, in such towns as Benson, Bisbee, Clarkdale, Coolidge, Flagstaff, Gila Bend, Kingman, Nogales, Phoenix, Prescott, Tempe, Tucson, Safford, and Yuma.

With expanded state interest in the drama came the need for special training, in turn calling for more comprehensive training in the theater arts. The University of Arizona offers four degrees in the field of drama: Bachelor of Fine Arts, Bachelor of Arts in Drama, Bachelor of Arts in Drama Education, and Master of Arts. Arizona State University offers a major in speech, and drama courses leading to a Bachelor of Arts degree through the College of Liberal Arts. Phoenix Junior College also gives extensive collegiate drama offerings in Maricopa County. Arizona State College at Flagstaff also lists its drama courses through the College of Liberal Arts and offers a combined major in drama, speech and English. Grand Canyon College in Phoenix and Eastern Arizona Junior College at Thatcher offer a combined major in speech and drama and an active program of dramatic presentations.

In Phoenix and Tucson high schools, drama has moved from the extra-curricular program to more specialized offerings for credit in the dramatic arts departments. Many other Arizona high schools offer drama in individual courses or through drama clubs. Creative dramatics is also being made a regular part of elementary and junior high school curricula throughout the state.

Standards for the drama in Arizona are high and recognition of merit has been received in every field of the arts and crafts of the theater.

The Sombrero Playhouse in Phoenix is the only continuous resident professional theater established in Arizona. This playhouse presents dramatic artists of national reputation and it also has offered previews of dramas and musical shows that have gone on to become major successes.

A Shakespeare Festival of sixteen plays is presented each season by the Phoenix Little Theater. The Festival was begun, in 1957, largely through

the efforts of Dr. Alfred Knight and has already earned a standing with many older Shakespearean events. The scope of the festival is state-wide with all community, university, and college theater groups participating. In connection with the plays, a program, Ye Olde English Fair on the Green, is presented.

Drama also plays an important part in the international exchange of cultural programs with the neighboring state of Sonora, Mexico. The Department of Drama at the University of Arizona is a vital force in the cultural work of the Arizona-Sonora Project for Intellectual Cooperation sponsored by the Rockefeller Foundation. This includes an active exchange program of plays between the Academia del Arte Dramática of the Universidad de Sonora and the University of Arizona Department of Drama.

The Arizona institutions of higher learning, and many of the major little theaters, feel a responsibility to encourage new playwrights and, therefore, emphasize the production of their plays.

As an outgrowth of this attitude and activity, a laboratory theater to foster original plays is being considered by the University of Arizona. The premiere performance of William Gibson's *Dinny and the Witches* was presented by the University and ran concurrently with Mr. Gibson's *Miracle Worker*. Charles Finney's *The Circus of Dr. Lao* was also premiered on the campus and was later presented professionally by Burgess Meredith.

The Dance

Sister to the drama, the dance now is beginning to attract great interest in Arizona, where until very recent years the religiously-oriented dancing of Indian peoples was probably the only well-defined expression of this vital form of art. Both Tucson and Phoenix abound in dancing teachers, and literally thousands of children are enrolled in classes in ballet, acrobatic, and interpretive modern dancing. The universities, colleges, and high schools almost all offer courses in modern dance, and Tucson holds an annual dance symposium giving a panoramic view of the work done in various dance forms by leading participants in the community.

Arizona, with the rest of the nation, has restored square dancing to the position of a regular community activity in the last two decades. This ebullient form of dance, flexible enough in character to provide recreation for all age groups, has seemed



—John D. Schiff

David Fredenthal's "The People" from U of A Gallery of Modern American Paintings

especially adapted to the informal social life of the Southwest. Even the garments worn by square dancers are especially available to and favored by Arizona people, including the colorful squaw dress with its wide, graceful skirts, and the squaw boots, both originating in this area.

Square dancing has become so popular that both Tucson and Phoenix and the counties adjacent, sponsor city and county recreation programs which include instruction and weekly dances at such places as Encanto Park in Phoenix and Old Tucson and the rodeo grounds in Tucson. Both cities have organizations of dancers and of callers, and both send delegates annually to the national square dance convention in Colorado. Daily papers in Phoenix and

Tucson contain weekly columns of news and calendars of square dance events. The general popularity of square dancing is reflected by similar activities in most of the smaller communities and by square dancing in the recreational programs of public and private schools, guest ranches, and social clubs all over the state.

The Latin influence is naturally felt in the developing interest in the dance in Arizona. Phoenix has a school of Flamenco, the Andalusian form of Spanish dance improvisation which has so engaged the attention of dance and music-lovers all over the nation. The dances of Spain, Latin-America, and, of course, Mexico are frequently seen in both Phoenix and Tucson as performed by travelling troupes

featuring such stars as José Limón, José Greco, Anna Marie, and Carmen Amaya.

Every concert season in the metropolitan areas is highlighted also by the appearance of world-famous dance ensembles. In 1959–60 these included the National Ballet of Finland, the Chicago Opera Ballet, the Ballet Russe de Monte Carlo, and the Takarazuka troupe from Japan.

Literature

The first inhabitants of our region were the Indians, whose literature was oral. Among any people whose traditions and stories must be passed down by word-of-mouth, great prestige attaches to those who tell stories. This is especially true of the keepers of religious myths and rituals. The Singer, the Shaman or Medicine Man, was a person of great influence. He carried in his memory the rituals necessary for curing the sick. He knew the religious myths which told how the world was made, how his own people came to be, and of the wanderings of his tribe before they came to the land of their residence. These stories were the ethical documents of his people, explicit in their instruction as to what should and should not be done. These rituals appear in the works of Washington Matthews and Father Berard Haile, who have made translations of Navajo myths. In reading them one enters a world utterly strange to a person brought up in our tradition.

But not all Indian oral literature is religious. There are folk tales of great variety; amusing, and frequently ribald, stories involving the sneaky trickster, Coyote; moving tales of love; and exciting ones of adventure in strange places. Though the folk tales are not primarily religious, the supernatural figures even more prominently in these Indian stories than it does in the European variety, for to the Indian there is spirit, life in everything. Though Indian folk tales have all the fascination of the unfamiliar to one brought up in our tradition, one is often warmed by the recognition of elements and themes similar to those found in Indo-European folk stories. Incidents in some of the stories, for example, explain an everyday phenomenon: why the mosquito has bent legs, why the coyote has pale eyes, or why the gnat darts here and there before he settles down to bite. There is a beautiful Zuñi folk tale whose theme is exactly that of the Orpheus legend: a youth goes to the Other world to bring back his dead beloved and is allowed to do so if he observes certain conditions. Of course the conditions are not observed, and the

maiden returns to the world of the dead forever. To those interested in this kind of Indian literature, Frank Cushing's *Zuñi Folk Tales* is recommended.

In addition to the public arts of rituals, myths and folk tales, the Indian composed in more personal forms. In Margot Astrov's *The Winged Serpent* or Frank Cronyn's *The Path on the Rainbow* are many moving poems or songs, for the Indian, like Homer, or like the bard of the time of *Beowulf*, always chants or sings his verses. Indian poetry is always concrete and it is most frequently incantatory.

Indians, then, produced a vital literature of their own. They also occupy a prominent position in works written by the Europeans who displaced them. The image of the Indian as it appears in such works has not remained static. In the earliest accounts, the Indian is often presented as a person who, though strange and unfamiliar in his habits and customs, is a friendly and helpful being. In the descriptions given by the early padres and conquistadors, it is impossible to recognize the savage, cruel, villainous Apaches depicted by writers of later histories.

But as the pressure of European immigration increased, and as the Indian realized a threat to his existence, he began to fight. He became, in short, the Enemy. It is a natural and understandable human characteristic to vilify one's enemies. Certainly one is not going to praise or even seek to understand the motives of those from whom one daily fears attack. Contemporary accounts therefore, of such events as the Wickenburg massacre or the events leading up to the Camp Grant massacre, depict the Indian as low, treacherous, savage and cunning. John Cremony's classic, *Life Among the Apaches*, though not as narrow as other early accounts, clearly implies that it is right for the "inferior" Indian to be replaced by the "superior" White Man. Leo Crane who in *Desert Drums* and *Indians of the Enchanted Desert* deals with Pueblo groups, is contemptuous of them for their opposition to the White Man's ways, their superstition, and their peacefulness.

The second stage, of hatred and contempt for the Indian, is succeeded by the present or third stage of greater understanding. Even earlier, of course, there was an occasional writer such as John Gregory Bourke whose work is marked by breadths of understanding. In his *On the Border with Crook*, Bourke shows a degree of human sympathy unusual for his day, but still shows a certain lack of insight.

The third stage in the attitude toward the Indian is marked by an attempt to present him, not as an

opponent, or even as a quaint member of a noble, though vanishing race, but as a man with all the hopes, aspirations, victories, and losses everywhere associated with the human condition.

Before the new trend in thought had many followers, Adolph Bandelier in 1890 wrote *The Delight Makers*, a novel of the Pueblo Indians who lived in Frijoles Canyon of northwestern New Mexico (now part of Bandelier National Monument). Lawrence Clark Powell says this book is "... first of a long line of southwestern Indian documentary novels ... never ... surpassed in its faithfulness to the facts of Pueblo Indian culture."

Three good books in terms of the third stage of feeling were published in close succession. Oliver La Farge's *Laughing Boy* in 1929 was followed two years later by Frances Gillmor's *Windsinger* and Will Comfort's *Apache*. *Laughing Boy* deals with one of the fundamental problems faced by an Indian educated in the manner favored by the government before 1933. It is the story of a Navajo girl in government schools, away from the reservation. She has been deprived of Indian culture without, however, being provided with anything adequate to take its place. Her attempts, misdirected and futile, to work her way back into Navajo life through marriage to Laughing Boy, a conservative, traditional-minded Indian, make an imaginative and moving tale. Miss Gillmor's *Windsinger* presents with great sensibility the inner life of a Navajo singer or shaman. Comfort's story has more action and suspense than the other two, but takes the Indian point of view. Further, and in vivid illustration of the new attitude, *Apache* deals with one of the White's most stubborn opponents, the great Apache leader, Mangus Colorado. Comfort presents the Americans as cruel, dishonest breakers of treaties; Mangus as a brave, honorable patriot, fighting for his beloved land.

The new attitude was consolidated by, and is probably best exemplified by Elliot Arnold's *Blood Brother*—in 1947–48 a runaway best seller which later was made into an equally popular motion picture *Broken Arrow*. The story is a complex one dealing with the friendship between the Chiracahua Apache leader Cochise and his American friend, Tom Jeffords, and the relationship during the same period between the Apaches and the White men. The reader's sympathies are enlisted on the side of Cochise, who keeps the peace as he has agreed, until it is irrevocably violated by an ignorant American army officer. Arnold's book has strongly



"Standing Nude" by Maillol — Phoenix Art Museum

influenced the spread of the new attitude, not only in books but also in television and motion pictures. *Blood Brother* has given Cochise a place in our national consciousness that he is not likely soon to lose.

There was truly not much settlement in Arizona before the American period, and there is a corresponding lack of literary documents dealing with the area. The first European visitors to our regions were Spaniards.

The seeds were planted for growth of some of the earliest literature about the area about June of

1540 when an impressive expedition of Spaniards under the command of Francisco Vázquez de Coronado rode down the San Pedro valley on the way to conquer the fabled Seven Cities of Cibola. About twenty years later one of Coronado's soldiers, Pedro Castañeda, wrote an account of this expedition in order, he says, to put a stop to the lying tales that were being told about it. Castañeda was a cool, hard-headed, and somewhat cynical old soldier whose account is one of the most fascinating stories of exploration that have come down to us.

For those who want a complete and judicious history of Coronado's whole career, the best work is *Coronado, Knight of Pueblos and Plains* by Herbert E. Bolton. Bolton was a historian, in fact the leading authority on Southwestern history, whose books are of such quality that they deserve a prominent place in Arizona literature.

Another highly recommended work by Bolton, *The Rim of Christendom*, deals with the most important European to enter Arizona between Coronado and the coming of the Americans—Padre Eusebio Kino. Padre Kino founded a chain of missions in Sonora, Arizona, and Baja California; he introduced cattle into Arizona, and is therefore rightly called the state's first cattleman; he brought European grains here; he was a great explorer and cartographer; but, above all, he was a humane, kindly man whose influence on the Indians he converted is still to be seen in their descendants.

In the period between the death of Padre Kino in 1711, and the real establishment of an American population in Arizona in the 1870's, books begin to be so numerous that a real problem of selection arises. The works dealing with Indians during this period have been discussed. The literature concerned with the Anglo-Americans was great in volume and high in quality.

A curious and most readable work is *Personal Narrative*, by James Ohio Pattie. In 1824, after various adventures in New Mexico, Pattie and his father, both Missourians, joined forces with several other American trappers and entered Arizona in search of beaver. They trapped on the Gila, the Salt, and the Colorado, all with considerable success. On the lower Colorado, to their ultimate sorrow, they succumbed to the lure of California. Having buried their furs on the banks of the Colorado, they went on to San Diego, where they were immediately jailed by the Mexican authorities. The father died in jail, but James Ohio won his freedom and also that of

a companion by knowing how to perform vaccinations during a smallpox epidemic. He vaccinated the entire population of the California missions, from San Diego to San Francisco. After that, finding his cached furs to have been ruined by spring floods, Pattie returned to the States by boat from Vera Cruz to New Orleans. The book, though it has its obviously romanticized parts, is a generally sound and vivid account of an early journey.

There are a great number of books about the Mexican War of 1846–1848. Three works about Arizona written by people who participated in the events they describe are outstanding. G. D. Brewerton was a young army lieutenant who, guided by Kit Carson, carried dispatches from California to the States, during the last year of the Mexican War. His *Overland with Kit Carson*, is more exciting than most fiction, and helped to make the quiet Carson famous. Lieutenant William S. Emory, in *Notes of a Military Reconnaissance*, describes the terrible struggle of General Kearney and his army across the desert from Santa Fe to California. Lieutenant Phillip St. George Cooke—the army seems to have been full of literary lieutenants—was in command of the famous Mormon Battalion, and later told its story in his memoirs. In *Scenes and Adventures in the Army*, he describes vividly and with humor the long trek of his battalion. They took Tucson without a shot fired in anger; indeed their only really rough encounter was with a herd of wild bulls in the vicinity of the present St. David, later to be established as a community by members of the party. More popularly, Ernest Haycox wrote of frontier military life in *Border Trumpet*.

The period of Arizona life most treated in literature is between 1870 and 1885, a statement which can be made of the Western literature in general. It is this period that has dominated the imaginations of millions of people, both in this country and in other lands. It was the time of the cattle empire, the open range, cattle drives, of the trail-end towns like Abilene and Fort Dodge, and it was the time also of the wide-open mining camps like Tombstone. This is the time, the books tell us, when the lean-flanked, gun-toting, quiet-spoken cowboy, a knight in a roping saddle, saved ranches and maidens, put down outlaws, and even, occasionally, punched a few cattle. It was the time also when steely-eyed lawmen, cool, deliberate, and as fast as lightning, faced down the badmen, who died with guns half-drawn in the hot dusty streets of western towns.

In short there has grown up in Western fiction



— Ray Manley

Modern silver and turquoise jewelry — typical of fine craftsmanship of Arizona Indians

what may be called the Myth of the Cowboy. Stories embodying this myth are widely popular not only in this country, but abroad. They fill many books, many hours of television time, and they have been motion pictures' mainstay since the time of Bronco Billy Anderson. Though the archetype of this form, Owen Wister's *Virginian*, was set in Wyoming, countless numbers of Westerns have been set in Arizona. Zane Grey, for a long time the dean of Western writers, lived in Arizona and set many of his stories here. Harold Bell Wright lived in Arizona and sentimentalized its scenes. Clarence Budington Kelland impressed Arizona on the minds of popular readers with his romance by that name and lives in the state still. Leslie Ernwein and Nelson Nye, two popular

writers of Western fiction live in Tucson, and in their stories the familiar mountains and deserts are recognizable. Thomas Blackburn, Frank Gruber, and W. R. Burnett, though they do not live in Arizona, have written suspenseful yarns laid in the state. Further, because so many motion pictures of the West are filmed in Arizona, the image of the West that many people hold is actually an image of the state.

In addition to the many fictional Westerns, we have a great many works dealing with the same period which are, or at least profess to be, factual. Concerning the confrontation of badmen by frontier marshals we have a number of books, most of which deal, of course, with the Tombstone of the 1880's; with Wyatt, Virgil, and Morgan Earp; with Doc Hol-



—Tad Nichols

Apache woman weaving baskets — a craft that is a vanishing art among many tribes

liday; with Curly Bill, Johnny Ringo, and the Clantons. Of these works, probably the best known, and certainly the most influential, is *Frontier Marshal*, the biography of Wyatt Earp by Stuart Lake. The Wyatt Earp of Lake's book has fascinated or irritated people for years. The critical question is that of the accuracy of Lake's portrait. This is no place to settle so involved a question, but a few words about the vividness and force of the book are in order. Lake has embodied here the image of the frontier marshal which has dominated the stereotype in countless novels, screen plays and television scripts. Read a book concerning a frontier peace officer and you will discern, lurking under the characterization, Lake's "lion of Tombstone", lean, agile, graceful, savage in his loyalties, deadly accurate in shooting, deadly efficient in pistol-whipping, and somehow mysterious in his aloofness and cold reserve. Whether or not the picture is an accurate one of Wyatt Earp is something for scholarship to settle, but even if research

should show that Earp was something different, one feels that the figure Lake has created here will continue to be seen in books and on screens for some time to come. The reader interested in pursuing the problem suggested here should consult Douglas Martin's *Tombstone Epitaph* and Pat Jahns' *The Frontier World of Doc Holliday* for relevant material.

There are many novels based on Wyatt Earp or the Earp type, most of which unhappily amount only to escape reading. There is, however, a recent novel, *Warlock*, by Oakley Hall which is a serious and ambitious attempt to deal with the moral issues raised by this epoch in our history. The story is plainly based on Tombstone and Wyatt Earp's career there. But unlike other writers dealing with the same material, Mr. Hall's characters are not mere stereotypes, but are real people who reveal what may have motivated men like Earp and Holliday.

The cowboy of fiction was one thing. What of the real cowboy? Cattlemen were the first solid citi-

zens of Arizona—mining camps rose and died—and their traditions are still important in Arizona culture. The first cattlemen were too busy establishing ranches to have time to write memoirs of their activities, but writers of the next generation tried to fill the gap. Ross Santee in *Cowboy* has given a vivid and true picture of the ordinary cowhand of a generation ago. Jesse Benton, who punched cows over some of Texas and all of Arizona, in *Cow by the Tail* has given his reminiscences of a life spent in the saddle. Dane Coolidge's *Arizona Cowboys* gives us a whole gallery, and Frazier Hunt's *Cap Mossman: Last of the Great Cowmen*, provides the reader with a biography of a great early day rancher. The point of view of the small rancher's wife—and a most important point of view that is—is excellently represented in Mary Rak's *A Cowman's Wife and Mountain Cattle*. Another favorite subject of Western writers is feuding between sheepmen and cattlemen. Arizona had what was possibly the most serious of those wars, ably narrated by Earle Forrest in *Arizona's Dark and Bloody Ground*.

On a different theme of history, the journals of David K. Udall, *Arizona Pioneer Mormon*, were edited by the late Levi S. Udall, judge of the Superior Court, and published in 1959 by Arizona Silhouettes. The Udalls were called by their church from their home in Utah to an unwelcoming environment at St. John's in the 1870's. The record of their experiences reflects the difficult Arizona life of that period and testifies to the contribution made by several members of the Udall family to the historical

and political structure of the state.

Finally, what of books about Arizona with more modern setting? They are generally different in nature from the works discussed so far which are peculiarly Arizonan—that is, it seems unlikely that the events described in these books could have happened anywhere else. Exceptions to this might be *Dark Madonna* by Richard Summers, a novel telling of the life of a Mexican family in Tucson in the Depression, and exhibiting a sympathetic insight into the Mexican-Indian behavior and community life; and Jack O'Connor's *Boomtown*, an earthy and accurate story of mining camp days in Globe.

In a recently compiled bibliography of Arizona fiction published since 1940, there are forty-five titles. Fifteen of these works are set in modern times; the rest would fall in one or another of the literary categories already mentioned. Of the fifteen, four have as leading characters members of one or another of Arizona's Indian tribes, and are certainly, therefore, peculiarly Arizonan. The other eleven are set in cities, which, in so far as the effectiveness of the stories is concerned, might as well be in Kansas as in Arizona. In fact, this is generally true of modern regionalism in America. The facility of travel and communications has greatly reduced the differences between parts of our nation, with consequent reduction in true regionalism. At an earlier time regions did differ, and for that reason two-thirds of Arizona's modern novels deal with a time long dead—a time in Arizona's history that fascinates writers, and very plainly fascinates readers too.



..... *education*

THE PEOPLE OF ARIZONA HAVE ALWAYS BEEN vitally interested in schools. The school-building efforts of its citizens cover almost a century of phenomenal growth and development. In 1864, the First Territorial Legislature granted \$250 to each of four school districts then established. Succeeding legislative bodies have continued to provide money for schools. Since 1871, changes notwithstanding, Arizona's aid to elementary and secondary schools has kept pace with the growth of the state and with national developments.

Public Elementary and Secondary Schools

SCHOOL DISTRICTS. With state statutes undergoing considerable revision, the establishment and modification of school districts in Arizona may be described only in general terms. Since earliest Territorial days, the school district has been the basic unit of public school organization and administration below the college level. Interested citizens can initiate a school district by a petition which is presented to the county superintendent of schools and acted upon finally by the county board of supervisors. Districts may be consolidated and boundaries changed by similar procedures.

Elementary and secondary schools form separate districts in this state. Advocates of this separation contend that bonding limits and certain other financial provisions are most advantageously administered in this manner. There has been agitation, however, for districts to be unified, with a single board in control of schooling from the first grade through the twelfth. Changes are difficult to bring about, however, in an organizational structure so long estab-

lished. Where elementary and high school district boundaries are identical the same members serve on both the elementary and high school boards. Nevertheless, separate budgets must be maintained and separate bond issues voted for the elementary and high school districts.

SCHOOL BOARDS. The people of a given community take the action to establish its schools, and control of the schools remains with these people. Direct administration is by district school boards which in Arizona consist either of three or five members, elected annually on the first Tuesday in October. School electors are qualified voters who have lived in the district at least six months. School board members must have similar qualifications, with minimum residence of twelve months in the district.

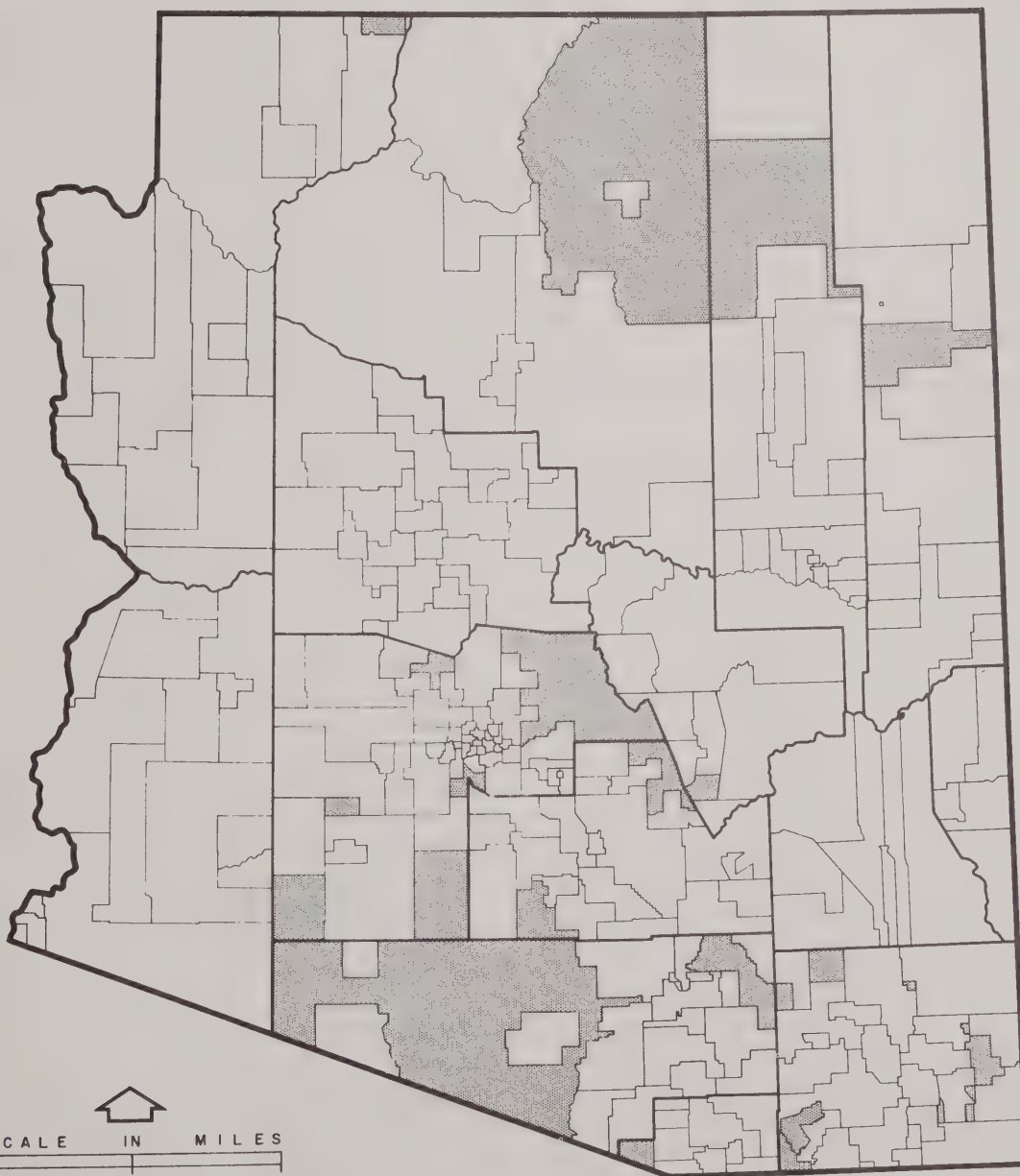
A school board should have enough members to represent diversity of viewpoints. In 1954, board membership for union high schools and junior college districts was raised from three to five. Of 230 present school boards with three members, 192 are elementary and thirty-eight are high school. Of seventy boards with five members each, thirty-five are elementary, thirty-four high school, and one, junior college.

District boards determine school policies and educational and financial programs. Research and reports on such policies, and the execution of them, are delegated to trained administrative personnel, of which Arizona has a large proportion. Districts of 300 or more pupils in average daily attendance may employ a superintendent and/or a principal. Schools with five or more teachers may employ a principal. Those with fewer than five teachers may employ a

ELEMENTARY SCHOOL DISTRICTS in the State of Arizona

L E G E N D

- | | |
|---|---|
|  STATE BOUNDARY |  ELEMENTARY SCHOOL DISTRICT BOUNDARY |
|  COUNTY BOUNDARY |  UNORGANIZED AREAS |



SCALE IN MILES
0 50 100 miles

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head teacher. Superintendents and principals are appointed for four years or less.

There is considerable freedom of administration within Arizona school districts. Certain legal specifications are made in the elementary school curriculum with respect to the state and federal constitutions and to health instruction. The state Board of Education influences the curricula of elementary and high schools, but is empowered only to make suggestions and recommendations.

This board has five *ex officio* members — the governor, the state superintendent of public instruction, and the presidents of the three publicly-supported four-year institutions of higher learning in Arizona. Other members include a county school superintendent, a city school superintendent, and a high school principal — all appointed by the governor. The constitution specifies the composition of the board. The state superintendent is elected to office for a two-year term.

County superintendents are also elected for two years. Their principal tasks are supervision of the finances of each district within the county, and supervision of educational work in districts which are without a superintendent or a principal.

Financial restrictions on school districts apply to budgeting procedure, bond limitation, building construction and use, auditing, control of expenditures and employment of teachers and other contractual situations.

ELEMENTARY SCHOOLS. The number of elementary school districts in Arizona has decreased greatly in the last forty years with the consolidation of some districts and the lapsing of others. A school district may legally be closed when average daily attendance for three months is less than eight pupils. Today's trend toward urban living has resulted in smaller enrollments in many of the outlying areas, with the consequent closing of certain schools. Improved transportation facilities, with more than one-fifth of the pupils regularly riding buses to school, have also affected Arizona school units.

School district size can be classified either by number of pupils or of teachers. In 1922, there were 255 "one-teacher" schools, sixty-two "two-teacher" schools, and forty-four schools with three or four teachers. By 1959, these figures had fallen to forty-five "one-teacher" schools, twenty-nine "two-teacher" schools, and twenty-eight schools with three or four teachers. The reduction in number of smaller schools is easily seen from these figures and also

from the fact that in 1922 some 10 percent of the elementary pupils were in schools with three or fewer teachers, while in 1959, fewer than 2 percent were attending one, two, and three-teacher schools. The proportion of elementary school pupils attending schools with five or more teachers now exceeds 97 percent, and over 86 percent of the pupils are attending schools that, in point of size, can present a reasonably satisfactory program of studies.

Arizona's total enrollment in public elementary schools in 1959-60 was 220,318, with average daily attendance 197,431. These figures suggest the influence of migrancy due to seasonal labor conditions in farming areas, and of winter tourists as transients in the Arizona resort areas. Nevertheless the total represents an increase of 7.67 percent over the figures for 1958-59.

Special provisions for elementary schools include the selection and distribution of free textbooks by the state Department of Education, using public-school funds. The school lunch program, a federal aid to education, is another factor in the elementary school complex. Other special provisions are the homebound teaching program for handicapped children, and instruction in specialized matter, such as, for example, the use of firearms.

HIGH SCHOOLS. In Arizona a high school district may have the same boundaries as that of the elementary school and be called a single district, or it may include several elementary school districts in what is called a union district. Arizona has fifty-one single and twenty union high school districts. Apache and Mohave counties each constitute a single high school district.

A separate board of five members, each elected for five years, serves every union high school district. In single districts, however, the elementary board of trustees serves automatically as the high school board of education.

There are eighty-eight separate schools in Arizona's seventy-one high school districts. Since more than 97 percent of the elementary school pupils in the state live in some high school district, it is apparent that secondary education is readily available to almost all young Arizonans.

Arizona high schools, as those in other states, are classified according to size of staff and nature of the curriculum. The State High School Visitor, who is also state chairman of the North Central Association of Colleges and Secondary Schools, classifies high schools. Arizona now has sixty-three

public high schools classified as North Central, twenty-two as Class A and three as Class B.

Enrollment in Arizona high schools, as in the elementary schools, is continually increasing. In 1958-59, the enrollment was 62,148 and average daily attendance was 51,560, a disproportion again reflecting the effects of migrancy and transient tourist population. Approximately one-half of the high school graduates in Arizona go on to college.

Courses and graduation requirements for Arizona high schools are described in a handbook published by the state Board of Education under the supervision of the State High School Visitor. General requirements for the high school diploma include three units of English, two of social studies, one of science, and one of mathematics.

As elsewhere in the nation, high school curricula in Arizona are being closely scrutinized and considerably modified. Modern problems and the current need for personnel trained along technological lines have increased the variety of demands upon the high school. It has been pointed out that for four out of five freshmen, high school will be the final organized educational experience; thus it is clear that the educational needs of this group are quite different from those of the high school graduate who is going on to college.

Because of these and other problems, guidance has come to be considered an extremely important service to high school students. In 1958-59, there were 221 guidance workers in the junior and senior high schools of Arizona.

PUBLIC SCHOOL TEACHERS. There were 7,721 elementary school teachers in Arizona in 1959. Over 99 percent of them have the bachelor's degree, which is required for the standard elementary school certificate. It is expected that in the near future the majority of these teachers will be graduates of Arizona institutions.

Teachers in Arizona high schools all have the bachelor's degree, many the master's degree, and some have doctorates. Six hours of graduate work are required for the pre-secondary certificate, and thirty hours for the secondary certificate. The pupil-teacher ratio in Arizona high schools is approximately 21:1. To maintain this desirable ratio in the face of the continually-increasing high school enrollment, the number of high school teachers increased from 1,408 in 1950-51, to 2,777 in 1958-59.

The year 1959 was marked by an increase in the number of certificates issued to new teachers in the

kindergarten-primary field, and in the fields of library, adult education, and guidance. The number of substitute certificates decreased.

Salaries for public school teachers in Arizona are well above the national average. The average salary for elementary teachers in Arizona is \$5,075, with a range from \$3,500 to \$7,500. Salaries are somewhat higher in high schools.

Arizona public school teachers are covered by continuing service provisions, i.e., after three years of employment in the same school district a teacher is considered to be a continuing teacher, provided he has not been notified of his dismissal for the next school year by March 15 of his third year of teaching in the district. It is still possible to dismiss a teacher after he has gained continuing-teacher status, but this dismissal must be for cause. Causes are specified in the continuing-teacher law.

Retirement pay for Arizona teachers is based upon contributions. Each teacher places 3.5 percent of his annual salary in his own retirement account and this amount is matched by the county. Individual accounts are kept and the teacher may ask to know his status from the Arizona State Retirement System which administers these plans. Like other employees, a teacher also contributes 3 percent of his salary to the Old Age and Survivors' Insurance plan of the federal Social Security Commission.

Teachers of Arizona are widely represented in local, state, and national professional organizations. With a membership of 92 percent, Arizona is one of the states best represented in the National Educational Association.

PUBLIC SCHOOL FINANCING. Public education is preeminent on the list of services provided to the people of Arizona by the state. School district taxes total 58 percent of property taxes and 29 percent of the non-federal taxes collected in Arizona. Eighteen percent of the governmental revenues collected in the state and 4 percent of the total income within Arizona are used for public schools.

Aid to Public Schools. Since 1871, Arizona has supported its district school by allocation of money from county taxes. In 1958-59 Arizona elementary school expenditures totalled \$60 million and high schools spent \$27 million. Costs per pupil were respectively \$322.20 and \$496.16. Adding capital outlay and debt service, the state averages per pupil became \$347.72 and \$546.26.

There is a large disparity in the assessed valuation of physical wealth represented by each pupil



— U of A

Law and Math Buildings under construction at the University of Arizona, Tucson

in Arizona's numerous school districts. In 1958–59 it ranged from \$171 to \$309,496, with an average of \$8,603 in the elementary districts; in high school districts the range was from \$2,794 to \$219,160 with an average of \$28,976.

During the 1958–59 year, elementary school tax rates ranged from \$.0000 to \$10.1592 per \$100 assessed valuation, with an average of \$2.51. High school tax rates ranged from \$.2060 to \$4.74 with an average of \$2.00. Total tax rates for all purposes ranged from \$1.53 to \$14.60, with an average of \$7.13. These figures, studied in relation to the wide variation of the wealth among Arizona school districts, enable one to glimpse the problems confronting citizens of low economy areas who have to pay a high rate of taxes in order to achieve satisfactory school financing.

Current Plan. Now functioning in Arizona is a foundation program for school financing with need, ability to pay, and effort as its basis. One and two-teacher schools are guaranteed either \$5,000 or \$9,000 respectively. The district is expected to levy a maximum tax of \$1.50 per \$100 of assessed valuation, supplementing the amount available per pupil

from state and county apportionment. If an elementary school district tax of \$1.50 fails to bring the total per pupil to \$275, the county is expected to make up the deficiency from the equalization fund. This fund should total a maximum of \$29 per pupil in the county, to be expended where needed. The recent increase in state aid from \$127 to \$170 has been financed largely by a one-cent increase in the sales tax.

The plan is similar for high school districts with a guarantee of \$425 per pupil, a state contribution of \$170 and a county contribution of \$10.00. Requisite tax rate before aid is available from the equalization fund is \$1.30 per \$100. Districts may, when they wish, exceed the minimum provisions of the guarantee.

With school attendance rapidly increasing, the effort is being made to place state and county support on a current basis. A budget figure for "computed attendance" is achieved by adding the increase of attendance during the year before the preceding year, and the preceding year, to last year's attendance.

The state treasurer keeps school district money in Arizona. It is disbursed on warrants issued by



— ASU

The Administration Building at Arizona State University, Tempe

county superintendents. Vouchers accompanied by invoices are made out by local district boards to authorize the warrants and all expenditures, of course, must be within the budget.

Federal Funds. All federal money for public schools and districts in Arizona must be administered by the districts. Among the sources of federal funds for Arizona schools is interest totalling one and one-quarter million dollars on money from the sale of eight million acres of land granted to the state for the schools by the Enabling Act of 1910.

Federal money for schools is allocated to such needs as school lunches (milk, agricultural commodities, lunch reimbursements), \$2,309,074; vocational education, \$516,051; Indian education (Johnson-O'Malley Act), \$1,686,752; school construction, \$3,901,099; current expenditures in schools in federally-impacted areas, \$3,172,781. Additional money is available from the Forest Reserve Act, and in varying amounts from year to year from other federal sources. In any fiscal year, the public schools of Arizona accept and use in excess of \$10 million from the federal government.

Private and Parochial Schools

Although accurate figures are not available, the private and parochial schools of Arizona enroll ap-

proximately 10 percent of the elementary school children, and approximately 7 percent of the secondary school pupils in the state.

Kindergarten is a chief function of private schools in Arizona, for there are relatively few public kindergartens and these have an enrollment only half as large as that of the private ones. Some educators strongly advocate extension of the state's educational program in this regard.

In both Arizona and the nation, parochial schools account for a major proportion of private school enrollment. At the elementary level, all Arizona private schools follow the state course of study, using state-adopted textbooks. Supplementary work, especially religious instruction, is given in the parochial schools.

Of Arizona's private high schools, one has been classified by the North Central Association as Class A and eight as Class B. In addition, there are five private high schools which belong to no association but which are all accredited to Arizona's three public four-year institutions of higher education.

Higher Education

From its beginning as a Territory in 1863, Arizona and its people have been concerned with higher education. Thus, the First Territorial Legislature meeting in Prescott established a state university,

and the governor appointed a board of regents of three members. Unfortunately, no funds were appropriated, and one member of the board was killed by Indians.

The legislation of 1864 lapsed; not until more than twenty years later was new legislation enacted. This initial effort towards the establishment of a university is significant, but the people of Arizona were not ready. At that time there was not a schoolhouse or public school, a courthouse or a railroad, in the entire Territory, and there were only two or three private schools. Indeed, not until 1871 did the first public school open, and the public high schools came some years later. The departure of federal garrisons from Arizona at the outbreak of the War Between the States had led the Indians to believe that they victoriously had forced the White man to retreat. The result was almost twenty-five years of bitter conflict with the Indians, finally terminating with the surrender of Geronimo and the remaining Apache warriors.

Interest in higher education continued, however, and in 1885 the Thirteenth Territorial Legislature, also meeting in Prescott, established the University of Arizona at Tucson, and the Arizona Territorial Normal School, now Arizona State University, near Tempe. Thus, the year 1960 marks the seventy-fifth anniversary of the founding of the University of Arizona and Arizona State University, and each of these institutions is conducting a year-long celebration in commemoration.

Despite Arizona's small population, two other institutions of higher learning were established before the nineteenth century ended. The Northern Arizona Normal School, now Arizona State College at Flagstaff, was founded in 1899, and the Latter Day Saints Academy, now Eastern Arizona Junior College, opened its doors to students in Thatcher in 1891.

Since that time, four other institutions of higher learning have been established — Phoenix Junior College, now Phoenix College, in 1920; the American Institute for Foreign Trade in 1946; Grand Canyon College in 1949; and the Regina Cleri Seminary of the Catholic Diocese of Tucson in 1956.

Thus, Arizona now numbers two state universities, a state college, and two junior colleges among its publicly-controlled institutions, and, among its privately-controlled institutions, a four-year college, an institute of foreign trade, and a Catholic seminary.

The two universities and the state college function under a single governing board, The Board of

Regents of the Universities and State College of Arizona, made up of the governor, the superintendent of public instruction, and eight additional members appointed by the governor for staggered eight-year terms.

With the approval of their respective institutions, many faculty people of the institutions of higher learning in Arizona participate as members of the Arizona College Association, founded in 1950. Annual meetings, held in rotation on the various campuses, provide a pleasant and effective means of communication and cooperation.

Judging by patterns in other states, it appears quite likely that the next decade will see the establishment in Arizona of one or more additional privately-controlled four-year institutions, and that of additional junior colleges. The establishment of such junior colleges has been made more likely by favorable action taken in 1960 by the Arizona legislature.

This legislation provides for a State Board of Directors of Junior Colleges, to include three ex officio members and fourteen members appointed by the governor, one from each county. It provides further that a single county, or two or more counties, may form a junior college district with a district board of five members, and establish and operate a junior college, provided that the college has a minimum enrollment of 320 equivalent full-time students, and that the district has a minimum assessed valuation of \$60,000,000.

State support for operation is provided at the rate of \$525 for each of the first 320 equivalent full-time students, and \$350 for each additional student. State support for capital costs includes an initial sum equal to the sum expended by the district, up to a maximum of \$500,000, plus \$115 per annum for each equivalent full-time student.

The location of the University of Arizona in Tucson, and that of Arizona State University close to Phoenix at Tempe, and the location of Arizona State College at Flagstaff, means that about three-quarters of the people of college age in Arizona have a publicly-supported, four-year institution of higher education within commuting distance.

Some of the history and much of the current picture of higher education in Arizona is revealed by brief separate accounts of the eight institutions. **THE UNIVERSITY OF ARIZONA.** Founded in Tucson in 1885, and opening its doors to students in 1891, the University of Arizona today is com-



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Forestry-Journalism Building, Arizona State College at Flagstaff

posed of ten colleges: The Colleges of Agriculture, Business and Public Administration, Education, Engineering, Fine Arts, Law, Liberal Arts, Mines, Pharmacy, and the Graduate College. Twenty-one divisions of research, extension, and special public service provide additional facilities for research, education, and cooperation with the citizens of Arizona. These divisions are: The Agricultural Experiment Station, Agricultural Extension Service, Applied Research Laboratory, Arizona Bureau of Mines, Arizona State Museum, Arizona Transportation and Traffic Institute, Bureau of Audio-Visual Services, Bureau of Business and Public Research, Bureau of Ethnic Research, Cooperative Wildlife Research Unit, Division of Continuing Education, Division of

Correspondence Instruction, Engineering Experiment Station, Geochronology Laboratories, Institute of Atmospheric Physics, Institute of Water Utilization, Laboratory of Tree-Ring Research, Numerical Analysis Laboratory, Poisoning Control Information Center, Radio-Television Bureau, and the Steward Observatory.

Throughout its history the University of Arizona has been the land-grant institution of the state, and thus is a part of the world-famous system of land-grant colleges and universities of the United States.

The Colleges of Education and Pharmacy are not organized as groups of separate departments and schools, but the remaining seven undergraduate colleges include fifty departments and three schools,

the schools being the School of Home Economics in the College of Agriculture, the School of Music in the College of Fine Arts, and the School of Nursing in the College of Liberal Arts. A department which corresponds closely to a school in other institutions is the Department of Architecture in the College of Fine Arts. In addition, there are two general departments and the School of Military Science and Tactics which are not associated with any particular college. Thus, the University of Arizona includes fifty-eight educational units separately organized on the basis of subject matter, including two undergraduate colleges not organized as departments, four schools, and fifty-two departments.

In the Graduate College, work leading to the master's degree is offered in sixty-nine fields, and that leading to the degree of Doctor of Philosophy is offered in thirty fields. Additional doctor's degrees offered are that of Doctor of Education and that of Doctor of Musical Arts.

At the beginning of the academic year 1960-61 there were 902 members of the faculty, and the on-campus enrollment of students for the first semester of 1959-60 was 11,772. During this same semester there were 968 students enrolled in courses held away from the campus, in the Tucson community, and in other communities of the state, and 1,283 students enrolled for correspondence courses. The enrollment for the first term of the summer session of 1960 was 4,341. As a part of its summer session the University of Arizona operates a special program in Guadalajara, Mexico, which, in 1960, was attended by 475 students.

The campus in Tucson comprises approximately 120 acres and includes sixty-five buildings. In addition, the University operates ten experimental farms located in various parts of the state; one near Marana, one near Mesa, two near Phoenix, one near Safford, three near Tucson, and two near Yuma.

The Agricultural Extension Service of the University of Arizona offers statewide service to farmers, ranchers, homemakers, and other citizens, with programs in each of the fourteen counties. This program is quite similar to that offered in other states by land-grant colleges and universities of those states. In a recent typical year, the program of this Service included, among other items, 3,778 meetings with a total attendance of 174,963 persons; the preparation and release of 5,756 informational items and programs; 17,967 farm and home visits, 21,025 office calls, and 29,449 telephone calls.

ARIZONA STATE UNIVERSITY. Located at Tempe, Arizona State University was founded in 1885 as the Arizona Territorial Normal School, which opened its doors to students in 1886. As a normal school it underwent several changes in name during the period 1885-1925. In the latter year it became Tempe State Teachers College, and a four-year college curriculum was established. The name became Arizona State Teachers College at Tempe in 1929, and the College was authorized to grant the degree of Bachelor of Arts in Education. In 1945 the name was changed to Arizona State College at Tempe and finally, in 1958, the College became Arizona State University.

Authorization to grant the degree of Master of Arts in Education was given in 1937, while in 1946 the degrees of Bachelor of Arts and Bachelor of Science were added. The College was authorized to award the degrees of Doctor of Education and Education Specialist in 1954, and the degrees of Master of Arts and Master of Science in 1956. Since that time, several specialized bachelor's and master's degrees have been added.

Arizona State University is now organized as five colleges: the Colleges of Liberal Arts, Education, Business Administration, Applied Arts and Sciences, and the Graduate College.

The College of Education is not organized as a group of separate departments, but the remaining three undergraduate colleges include thirty-one departments, two divisions which are not made up of departments, and three schools — the School of Architecture and the School of Engineering in the College of Applied Arts and Sciences, and the School of Nursing in the College of Liberal Arts.

The departments of the College of Liberal Arts are grouped as divisions, but within the College of Applied Arts and Sciences there are two divisions which are not made up of departments, the Division of Agriculture, and the Division of Industrial Education. Thus, Arizona State University includes thirty-six educational units separately organized on the basis of subject matter.

In the Graduate College, work leading to the master's degree is offered in twenty-two fields, and work leading to the doctor's degree is offered in education. An additional degree is that of Education Specialist.

There are also six units of research, extension, and special public service. These include the Bureau of Government Research, the Poisonous Animals

Research Laboratory, the Bureau of Educational Research and Services, the Bureau of Business Services, and the Research Center of the College of Applied Arts and Sciences.

At the beginning of the academic year 1960-61 there were 540 members of the faculty, and the on-campus enrollment for the first semester of 1959-60 was 10,275. During this same semester there were 1,157 students enrolled for courses held away from the campus, and 540 students enrolled in correspondence courses. The enrollment for the first semester of the summer session of 1960 was 4,308.

The campus proper comprises 220 acres and includes more than sixty buildings. In addition, Arizona State University operates a 360-acre model farm.

ARIZONA STATE COLLEGE AT FLAGSTAFF. This college was founded in 1899 as the Northern Arizona Normal School, and opened its doors to students that same year. In 1925 the name was changed to Northern Arizona State Teachers' College, and a four-year curriculum was established. Four years later, the name was changed to Arizona State Teachers' College at Flagstaff, and in 1945 this became Arizona State College at Flagstaff.

In 1925 the College was authorized to grant the degree of Bachelor of Arts in Education. The degree of Master of Arts in Education was added in 1937, and those of Bachelor of Arts and Bachelor of Science in 1946. The degree of Educational Specialist was authorized in 1954, those of Master of Arts and Master of Science in 1956, and in 1959 the degree of Bachelor of Science in Forestry was added. The College is organized around seven divisions, and includes, in accord with its historical background, a comprehensive program in education. The seven divisions are those of Liberal Arts, Teacher Education, Business Administration, Forestry, Technology and Applied Arts, Science and Mathematics, and General Studies. The Atmospheric Research Observatory includes a twenty-four inch reflecting telescope. The master's degree is offered in six fields.

At the beginning of the academic year 1960-61 there were 110 faculty members, while the on-campus enrollment for the first semester of 1959-60 was 1,691. During this same semester 694 students were enrolled for extension and evening courses, and 221 for correspondence courses. The enrollment for the first term of the 1960 summer session was 1,021. The campus today comprises 169 acres and includes thirty-two principal buildings.

GRAND CANYON COLLEGE. A four year college, owned and operated by the Baptist General Convention of Arizona, Grand Canyon College was chartered in Prescott in 1949, and first opened its doors to students in that same year. In 1951, however, the College was moved to Phoenix, where the campus comprises 160 acres and includes twenty buildings.

The College is organized as nine departments, and grants the degrees of Bachelor of Arts and Bachelor of Science. Teacher-training is included at the kindergarten, primary, elementary, and high school levels.

There are forty-eight members of the faculty listed in the 1960-62 catalog, and the enrollment for the first semester of 1959 was 468, while that for the first term of the 1960 summer session was 249.

THE AMERICAN INSTITUTE FOR FOREIGN TRADE. The privately-supported American Institute for Foreign Trade, located six miles from Glendale near Phoenix, was founded in 1946 with the purpose of establishing a "national center of higher education where young men and women might prepare themselves for careers in international commerce, either as employees of world-minded business concerns, or in the Government service."

In 1960 more than 750 of some 2,500 graduates were actively following such careers in seventy or more foreign countries or possessions, with strong representation on every continent, but with special concentration in Middle and South America. At the same time, at least an equal number hold domestic posts in foreign trade, or are in training for eventual assignment overseas.

The three chief areas of study are foreign languages, area studies, and the business administration of foreign trade. Persons holding a recognized baccalaureate degree may complete the requirements for the degree of Bachelor of Foreign Trade in two semesters, while those who enter after three years at a recognized college or university need four semesters to complete the requirements for this degree. Students who enter with a recognized baccalaureate degree may complete in four semesters the requirements for the degree of Master of Foreign Trade.

A limited number of highly selected candidates, who have completed the first two years at a recognized institution of higher learning, may complete in two semesters the requirements for the Certificate of Graduation. Additionally, persons wishing intensive study in one field, and who do not wish to

receive a degree, may enroll as special students not subject to the basic curriculum requirements.

There are thirty-nine members of the faculty listed in the 1960-62 catalog, while the enrollment for the first semester of 1959-60 was 273. The entire property of the Institute includes 180 acres, of which the buildings occupy forty acres of landscaped grounds.

PHOENIX COLLEGE. Centrally located in Phoenix is Phoenix College, which is a unit of the Phoenix High Schools and Phoenix College System. It was established in the fall of 1920 as a junior college, although it was not until 1927 that the state legislature passed an act formalizing the creation and maintenance of junior colleges in Arizona. In 1947 the Board of Education named it Phoenix College.

The College was first housed in the Phoenix Union High School, but in 1939 it was moved to the present campus which consists of fifty acres and includes fifteen buildings. A single curriculum was offered in 1930, whereas there are now more than thirty. All graduates receive the degree of Associate in Arts. The catalog for 1960-61 lists 103 members of the faculty. Enrollment for the first semester of 1959-60 was 2,262 day-students, and 3,340 evening students. The summer session enrollment in 1960 was 810 day-students and 1,153 evening students.

The purposes of the college are:

1. To provide two years of collegiate work acceptable to other institutions of higher education for students desiring to transfer.
2. To provide vocational education for students who do not plan to transfer to other institutions of higher education.
3. To provide such subjects as will contribute to the civic and liberal education of those in the community who are qualified to take advantage of them.
4. To enable the student, through an abundance of opportunities for participation, to assume an ever-increasing measure of responsibility in solving his own problems in college and in general.
5. To make possible the continuation of the education of adults.

The College also makes facilities available to four-year institutions of the state, for the purpose of offering extension courses for upper division or graduate credit.

EASTERN ARIZONA JUNIOR COLLEGE. The Church of Jesus Christ of Latter Day Saints established the Latter Day Saints Academy in Thatcher in

1891, and the doors were opened to students that same year. College courses were offered for the first time in 1921, and in 1926 the institution was accredited officially for two years of college work. Between 1891 and 1930 there were several changes of name; in 1930 the name became Gila Junior College.

In 1933 the citizens of Graham County voted to accept the College from the church as a county junior college, and the name was changed in 1950 to Eastern Arizona Junior College.

The program, which includes twenty-eight curriculums, is designed primarily for students planning on four or more years of college. A number of courses, however, qualify students for employment without further college preparation. All graduates of two-year curriculums receive the degree of Associate in Arts, and one-year secretarial graduates are given a secretarial certificate. Certain courses, carrying upper division or graduate credit, are offered on the campus of Eastern Arizona Junior College by the University of Arizona with the cooperation of the College.

The catalog for 1960-62 lists twenty-eight members of the faculty, and the facilities include fourteen buildings on the fifteen-acre campus. During the first semester of 1959-60 on-campus enrollment was 448, while the off-campus enrollment was ninety-two. **THE REGINA CLERI SEMINARY.** The Catholic Diocese of Tucson founded this seminary in 1956 in Tucson as an institution for the intellectual, physical, and spiritual training of young men preparing for the priesthood. Four years of secondary school and the first year of college are now offered.

A review of the programs of the colleges and universities of Arizona reveals that, with three notable exceptions, the professional programs commonly associated with American universities are available within the state.

No school of medicine, dentistry, or veterinary medicine has been established in Arizona. Beginning in 1960, however, the Board of Regents, using funds provided by the Commonwealth Fund, is conducting a thorough study of the needs of the state in the specific area of medical education. In the meantime, Arizona is participating very actively in the program of the Western Interstate Commission for Higher Education (WICHE).

Under the WICHE Program, Arizona students who gain admission to a medical, dental, or veterinary medical school in any one of the thirteen Western states which have one or more such schools,

may attend at a cost to themselves no greater than that paid by a resident of the state in question. The institution which accepts a student receives compensation also from funds provided by the Arizona legislature, as an additional payment in part of the total annual cost per student at that institution.

An important requirement under the present Arizona statute is that each participating student must either practice in Arizona one year for each year for which support was received, or refund to the state one-half the money expended for the year or years in question.

A general look at higher education in Arizona reveals that, to quite a remarkable degree, educational programs are available in the various fields and at the various levels commonly provided by the most highly-developed universities of the United States. To quite a remarkable degree also, the development of programs of research, extension, and special public

service has paralleled that in these universities.

Conclusion

Abundant in economy and rich in educational achievements, Arizona's schools, colleges and universities — public and private — are among the state's most prized resources, a true heritage from the vision and industry of the pioneers. The vivid past of the state is typified by the struggle against frontier odds to establish a good educational system. The dynamic present of Arizona can easily be found in the exploding school and college population and in the problems faced by administrators of both public and private schools in financing new construction. Arizona's place in the world of tomorrow may well depend upon its educational institutions, where Arizona's youth are learning to build for a greater future. The heritage of today is their challenge; our achievements their starting point.



. *religion*

THE SEA OF FAITH HAS BEEN AT THE FULL IN Arizona from the days of pre-history to the present. From the beginning it has been a faith combined with works, aimed not only at mystical experience and salvation, but at mastery of external difficulties — poverty, wars, and the weather — and at an adaptation of the individual to living with his fellows on the frontier. It is a faith which works today, as demonstrated in the large number of new churches built every year in Arizona, in increased church attendance, and in the active councils and associations channeling the energies of church members into the various ramifications of social betterment.

It is interesting to note that several of the major religions of the world took shape in an environment similar to the Arizona desert. Relentless sun, pursuing winds, the monumentality of mountains and sweep of heavens told early peoples of the Middle East that man and his lonely efforts were of trifling size. These forces were at work on the pioneers, and are with Arizonans today — reminders of the need for humility, broad thoughts, and harmonization with the principles of nature and of human welfare.

The religions that have developed in Arizona all have these concerns in common. They are divided, as religions the world over, into several large groups, and those in turn divided according to the needs and inclinations of the members. A survey of the larger groups delineates the historical and current picture of religious development in the state.

The Indian Religions

Religion among the Arizona Indians is basically nature worship. For centuries the chief concern of

all native tribes has been with the elements, always with the idea in mind that they might control wind and weather for the common good of Indian life. In simple agricultural societies, religion was an expression of a deep desire that the crops should grow. Lingering elements of hunting inspired the worship of animals in one form or another. Ever-present warfare demanded purification rites to rid one of the evil spirits which infested one who came in contact with death. With the disappearance of war, there was a transfer to the idea of casting out the equally malignant spirit which caused illness and death.

Navajo religion is centered in the belief that "Every daily act is colored by their conception of supernatural forces, ever present and ever threatening." There are small daily observances, such as greeting the morning sun with prayer. Rites of passage, such as birth and puberty, are performed. The Navajos are greatly afraid of ghosts which they believe to be witches from the world of the dead, and these ghosts may appear as coyotes, mice, or even humans; they will chase people, throw dirt on them, or otherwise cause them ill. Witches, who are evil men or women who may wear the hide of a coyote or a wolf, may cause loss of property, or sickness, or death.

Perhaps the greatest concern of the Navajo is with disease. The actions of ghosts and witches or the "holy people" may cause sickness. Thus, it is believed that the cure rests in contacting supernatural forces, and not with the sickness as such. The ill man goes to a hand trembler, who is a diagnostician and tells him the proper "chant" or "sing" which will cure. He goes next to the appropriate medicine man



— Tad Nichols

Navajo sandpainting — an important part of most Navajo ceremonial rituals

who in turn administers the correct chant. Among these are the Beauty Way Chant for propitiating snakes, the Mountain Top Way for difficulties with bears, or Shooting Way, if thunder or lightning are involved. The curing rite is based on a myth, and the myth reflects the Navajo's imagination, sense of beauty, and poetry of soul.

The Navajo believes in many powerful beings. Among them are Changing Women, the essence of nature and the seasons; the Twin War gods who rid the earth of monsters; and the Sun god, perhaps the most powerful of them all. Navajo rituals are colorful, with rich paraphernalia such as prayer sticks, rattles, and other musical instruments, beautiful and elaborate sandpaintings, and masked and costumed dancers.

Hopis have worked out an elaborate system of reciprocity between human beings and the supernatural. They seem to believe that if they do not perform certain specific rituals, the sun will not shine, the rain will not fall. Order prevails, and along the

four-fold path of life marked by childhood, youth, adulthood, and old age, the stages are marked by appropriate ceremonies.

A ritual calendar establishes the cycle of Hopi ceremonies which are given by secret religious societies. There are two periods for ceremonies, the more important one between the winter and summer solstices (roughly December 21 to June 21), and the period for lesser rites in the remaining six months of the year. Some of the rites include the *Powamu* or Bean ceremony, given in February for the initiation of young boys and to stress germination; *Niman*, the time of crop maturation and also the occasion of the return of the kachinas to their mountain top homes; and the Snake Dance, in August, to bring the late rains.

Kachinas are as important to the Hopi as they are difficult to define for the White man. They are spirits of the ancestors of the Hopi; they are intermediaries between man and the gods. For one-half of the year they live on top of the San Francisco



— Tad Nichols

Apache Crown Dancers in Mountain Spirit Dance, part of ceremony of girls' puberty ritual

Mountains and other peaks; the other half they are in the Hopi villages and may appear on occasion as costumed and masked dancers. Colorful kachina dolls are carved and painted in bright colors and given to Hopi children that they may better know the "real thing" when it appears in the village.

The Hopis have many gods, too. There is Masau'u, the god of the underworld and fire. "Spider Woman" is at the center of the Universe; she gives the Hopis their major properties and skills but also witchcraft and death.

Apache Indians have no religious societies, no ceremonial calendar, and, today, not many native ceremonies. The most prominent surviving ritual is the girl's puberty rite. The girl, her godmother, a medicine man, chanters, and drummers, and the Crown dancers are the main performers. Throughout the ceremony the girl is associated with White Painted Woman, a mythical being who embodies the ideal of Apache womanhood. The Crown dancers perform in the evening lighted by great campfires.

Like other Arizona Indians, the Apache personify the elements of nature about them — the sun, moon, stars, mountains, lightning, and many others. Many of these appear in their sandpaintings which are part of curing rites.

In the past, the religion of the Pima and Papago Indians of southern Arizona centered about nature worship. Pimas have all but abandoned their native faith; Papagos retain a few of their own religious observances. Among some of their recent or current expressions and beliefs are the following. Shamans perform rites for curing, weather, war, and crop growth. Power is received in songs and dreams. "Singing" is very important; they sing up the corn, sing over the new-born babe. Formerly a scalp dance was very important, with old women dancing about the pole with the enemy scalp fastened at the top; the successful warrior had to be ritually purified after his contact with death. Several ceremonies have been important: the wine-drinking ritual to bring the rain (wine made from saguaro fruit) and the *wiikita*, or

harvest rite, a masked performance of thanksgiving.

Perhaps the most interesting aspect of the religion of the Yuman tribes of Arizona is the mourning rite. As it is with most of the tribes speaking this language, the ritual is well represented in the Mohave custom. Formerly the rite was held at the time of death, culminating in the cremation of the deceased. Then it was customary to have a single annual ritual at which time all families having lost a loved one gathered for the occasion. Images of the deceased were made, and at specified times the families gathered about and mourned. At the end of four days the images were all burned on a funeral pyre.

All Southwest tribes have a rich mythology. Stories of their origins are told, of the creation of the world and life, and mountains and rivers. Coyote is a favorite "rascal" in many of their tales. All have a number of deities, some clear and concise, others rather hazy and dim. All have, or have had, rituals of some sort, simple or more complex. The Hopis have priests and priesthoods, the other tribes have shamans or medicine men. Ritual paraphernalia is simpler in some Arizona tribes, more elaborate in others. But a deep and abiding faith in nature marks the religion of all these Indians. Through the centuries their religion has guided them in the right way to do things; it has been a balance wheel, it has given strength and a sense of well-being in a not too kind environment.

Spaniards entered the state of Arizona with great fervor for religious conversion. Many natives became Catholics and their descendants have remained in this faith. Later Anglo-Americans added further Christian denominations to Indian worship. Today some tribes have embraced Christianity completely while others are but partially converted. The tribes of Arizona preserve the greatest number of aboriginal religious rituals of any group in the United States.

Catholics in Arizona

The Catholic Church in Arizona dates from 1539. In that year Fray Marcos de Niza, a Franciscan priest from Mexico, penetrated the region in his quest for the famed cities of Cibola. Whatever one's judgment as to the value of the report of his investigations, there is no doubt that he came as a priest and announced the Gospel at various Indian villages along the way. So far as is known, he was the first to carry the Cross into these lands.

For the next 300 years, the existence of the Catholic Church here was of a missionary nature.



— Ray Manley

San Xavier Mission — still used for services

Arizona stood at the frontier of the colonial expansion of Spain; and the work of this church lay in the labors, first of the Jesuits and later of the Franciscans, who labored to Christianize the Indians and establish among them missions as centers of Christian culture. To this era belong the names of the Jesuit, Father Francisco Kino, and the Franciscan, Father Francisco Garcés, and a long list of other devoted priests from both of these Orders.

These three centuries of missionary activity formed the backdrop for the establishment of the Catholic Church in Arizona. The beginning of flourishing Catholic life which we see on every hand goes back about 100 years.

When, through the Gadsden Purchase, the land south of the Gila River became part of the United States, the ecclesiastical jurisdiction was transferred from the Bishop of Sonora, Mexico, to the Bishop of Santa Fe. At first the people of this new territory were attended by priests from New Mexico who made occasional visits to Tucson and the surrounding area. In 1866, Bishop Lamy of Santa Fe sent Father John Baptiste Salpointe and two other priests into Arizona to establish permanent parishes in Tucson and Yuma. Two years later Rome established Ari-

zona as a separate jurisdiction by making it a Vicariate Apostolic and appointing Father Salpointe as the first Vicar Apostolic.

Father Salpointe went to his native Diocese of Clermont in France to receive his Episcopal consecration on June 20, 1869. He returned with six French priests who volunteered for work in Arizona. These were stationed in the various towns which were springing up like mushrooms throughout the vicariate.

Because priests were badly needed, even in the more developed parts of the country, for many years the bishops of Tucson had to rely upon France and other parts of Europe for recruits to meet the needs of the new communities. To the young ecclesiastical student of France, Arizona in those days presented a missionary challenge no less attractive than China or Africa.

The life and culture of Arizona were as different from France as one could find. Each new missionary was confronted immediately with the necessity of learning two languages, Spanish and English, and of adapting himself to a new mode of existence. For that reason the Cathedral rectory in Tucson became a sort of training school for volunteers for the Arizona missions. As soon as they gained a sufficient knowledge of the languages and people, the missionaries were sent out to the more important communities of the state to establish parishes often comprising several hundred square miles. For instance, the first pastor of Florence had included in his parish such far-flung settlements as Globe and Solomonville on the east and Tempe and Phoenix to the west. The pastor of Prescott had all the northern part of Arizona. The priests of Tucson cared for the entire southeastern part of the state with missions at Benson, Tombstone, and Bisbee.

As the various settlements developed, new parishes were set up and the territory divided. As late as 1923, when Bishop Gercke came to take over the diocese, St. Mary's in Phoenix was the only parish in Maricopa County. The Franciscan Fathers in charge of it not only cared for the people of Phoenix but also for those living in the towns of Glendale, Peoria, Wickenburg, Tempe, Mesa, and Chandler.

The labors of the Jesuit missionaries in the seventeenth century and the Franciscans in the eighteenth, had been principally among the Indian tribes. Accordingly, the Catholic Church has always been very proud to number among her adherents a great number of souls from the various Indian tribes of the

state. A network of missions extends throughout the Papago land on the south to the Gila Valley, and through the Apache reservations in the White Mountains up to the Navajos in the north.

One of the first concerns of Bishop Salpointe when he began his administration of the Church in 1868 was to provide schools and hospitals. He appealed to the Sisters of St. Joseph of Carondelet, Missouri, who in 1870 sent seven sisters to Tucson to begin a school and later a hospital. From this beginning has developed the Catholic school system which spreads throughout the state, and the fine hospitals of St. Mary's in Tucson, St. Joseph's in Phoenix, and St. Joseph's in Nogales.

For years one of the great works of the Catholic Church was St. Joseph's Orphanage conducted by the Sisters of St. Joseph in Tucson. In its day it cared for children from every part of the state. It was closed some twenty-five years ago when more advanced ideas of social service made its continuance unnecessary. However, new social problems have confronted the Church and to meet them the Convent of the Good Shepherd was opened in Phoenix to provide facilities in the state to take care of delinquent girls. Recently a home for the aged has been built in Phoenix by the Little Sisters of the Poor.

The history of the Catholic Church in Arizona has been one of continuing expansion, keeping pace with the growth and development of the state. Four bishops have ruled the Diocese of Tucson; Bishop Salpointe, Bishop Bourgade, Bishop Granjon, and Bishop Gercke. Since 1939, the northern counties of the state have been under the jurisdiction of the Most Reverend Bernard T. Espelage, O.F.M., the Bishop of Gallup. Each has made his own special contribution to the expansion and development of the Church. The number of priests in the state has steadily increased from three in 1866, to nearly 300 at the present time. Some 150 secular priests are attached to the two dioceses of Tucson and Gallup. The others are representatives of eight different religious orders. In like manner, the work of the Sisters of St. Joseph has been augmented by sisters from twenty-two other religious communities, to give the people of the state their dedicated labors in schools, hospitals, and institutions for social service.

In 1953, the Most Reverend Francis J. Green was appointed Auxiliary Bishop to assist Bishop Gercke in the ever-increasing work caused by the continuing growth and development of the Church. Through all these years the Church here has had to



The Mormon Temple at Mesa

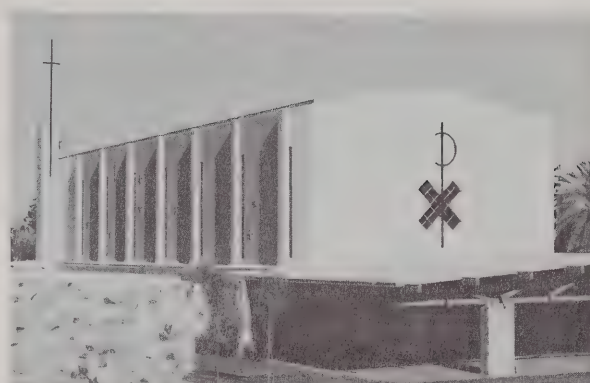
draw heavily from other places for its personnel. France, Ireland and the eastern parts of the United States have been more than generous in supplying bishops, priests, and sisters.

As the Church begins the next hundred years of its work in the state great problems lie ahead of it. Among these is the need of more priests and sisters. These will be drawn more and more from the people of the state. A seminary has been built in Tucson to educate young men for the priesthood, and several of the religious communities of sisters have established novitiates in the diocese to train young women for the various sisterhoods. As the state continues to grow and develop, the Catholic Church is prepared to keep pace. For the future its program will be more parishes, schools, hospitals, and kindred institutions of Christian charity.

Latter-Day Saints in Arizona

In 1960, membership of the Church of Latter-Day Saints in Arizona, including the fourteen organized stakes and the Arizona district of the California Mission, was 52,051.

Arizona was known to the Latter-Day Saints from 1846, when the famous Mormon Battalion passed through the Territory on its march from the Missouri River to the Pacific coast. As early as 1865, LDS settlers made homes in Arizona and in 1873, missionaries were called by the church authorities to locate settlements in the Territory. Quite a number of teams with settlers proceeded as far as the Little Colorado River that year, but returned discouraged. In 1876, however, a second attempt, more successful, was undertaken, and led to the founding of four settlements on the Little Colorado River. These were organized into a stake of Zion,



— Phoenix Chamber of Commerce

All Saints Episcopal Church in Phoenix

and called the Little Colorado Stake. As the population increased, the east part of that stake was organized as the Eastern Arizona Stake in 1879. In the meantime, however, the settlers on the lower Little Colorado became discouraged because of the frequent washing away of their dams. All the original settlements there, with the exception of St. Joseph, were broken up. The Eastern Arizona Stake, organized in 1879, was absorbed by the St. Johns Stake organized in 1887, and the Snowflake Stake, 1887. These latter stakes have since had a continuous existence.

In the meantime, on the Gila and Salt rivers, other settlements were founded, which led to the organization of two stakes of Zion, namely, the St. Joseph Stake, and the Maricopa Stake, both organized in 1883. These stakes, occupying land in a lower, or semi-tropical country, have also had a continuous existence since organization.

As the membership of the LDS Church in Arizona increased, and the settlements of the Saints in this state were so far removed from the headquarters of the Church, or from the temple cities in Utah, it was decided to erect a temple for Arizona, New Mexico, and southern California. The site chosen was in Mesa, Maricopa County, Arizona; the temple was dedicated October 23, 1927.

Of strictly fireproof construction, modern, rectangular, and somewhat neo-Classic in style, the temple is built with an independent reinforced concrete frame of columns, beams, floor slabs, and roof. Exterior walls are brick with terra cotta facing.

At the four corners, in the frieze portion of the cornice, are sculptured panels depicting the gathering of Israel from all nations in this dispensation. On the exterior walls are splendid mural paintings and in

the baptismal room, which is finished in colored faience tiles, is the baptismal font, resting on the backs of twelve life-size sculptured oxes.

The exterior of the temple proper measures 81 by 105 feet and rises three stories. The entire building, including the annex, measures 128 by 184 feet.

It is the ninth of fourteen temples built by the Latter-Day Saints and one of the eleven erected in the United States; the others are in Canada, Hawaii, Switzerland, England, and New Zealand.

Latter-Day Saints elders have given special attention to the Indians and Mexicans in Arizona. The Papago Ward in the Maricopa Stake consists almost exclusively of Indians, with members principally from the Papago and Maricopa tribes.

Jews in Arizona

The Jewish community of Arizona has never been a large segment of the general population, but its impact in civic and cultural affairs has always been significant. The early Jewish settlers gravitated from San Francisco or took the long transcontinental trek from the crowded cities of the East. Many of them were immigrants or children of refugees who fled from Europe in the period of the 1848 revolutions. They came to the New World seeking the exercise of religious liberty, freedom of political expression, and the privilege of economic opportunity. On the Western frontier they demonstrated both freedom of initiative and a democratic spirit.

Herman Ehrenberg is a case in point. A mining engineer and former fighter for Texas independence, he came to the Territory immediately after the Gadsden Purchase and associated himself closely with Charles D. Poston, "the Father of Arizona." The town of Ehrenberg, named after him, was, in its day, the most important community in the Territory, a key shipping point via the Colorado River and a terminus of the noted Wickenburg-Ehrenberg stagecoach route. Ehrenberg was a member of the 1856 convention demanding the separation of Arizona from New Mexico. He was also a delegate in the first Territorial convention of 1863. He served with Kit Carson and General Frémont, but his promising career was ended when he was killed by the Indians in 1866.

Other Jewish pioneers who gave their names to Arizona communities include Joe Mayer, Jacob Isaacson, and Isador Elkan Solomon. There were other colorful personalities. David Abraham, one of the first discoverers of copper in Arizona, insisted

on carrying a complete set of Shakespeare at all times, even while building the first wagon roads. He was considered one of the literary authorities of his day. Dr. Herman Bendell served under President Grant as superintendent of Indian affairs for Arizona. Selim Franklin, assistant United States attorney general, fathered the bill creating the University of Arizona.

It is estimated that there were less than fifty Jews in Arizona during the seventies. This number had increased to 2,000 by the turn of the century. At that time, the principal Jewish settlements were in Tucson, Phoenix, Prescott, Douglas, and Bisbee. Informal Jewish services were held on Sabbaths and festivals whenever a quorum of ten worshippers could be brought together. Services were held at private homes or in rented quarters.

Temple Emanu-El was the first Jewish congregation organized in the Territory of Arizona. The first edifice, built in 1910 at 560 South Stone Avenue in Tucson, still stands. In 1949, Temple Emanu-El moved to its new quarters at 225 North Country Club Road. Its present rabbi is Albert T. Bilgray. In 1960, Temple Emanu-El is commemorating its fiftieth anniversary.

A decade following Temple Emanu-El came the organization of Temple Beth Israel in Phoenix, now located at Tenth and Flower. Its rabbi is Albert Plotkin. Within another decade came Congregation Anshei Israel of Tucson, whose rabbi is Marcus Breger. Other synagogues include Beth El Congregation (Rabbi Carol Klein) and Beth Israel Congregation (Rabbi William Greenberg) in Phoenix and Young Israel Synagogue in Tucson.

Until 1940, the Jewish population throughout the state did not exceed 2,000. They constituted at that time less than one-half of one percent of the general population. In the last two decades Jews have joined fellow Americans in finding their way to Arizona. They now number approximately 14,000, representing a little more than one percent of the state's population. They continue, however, to play a highly significant role in cultural and civic life.

Protestants in Arizona

The date of arrival of the first Protestant minister or missionary in Arizona is unknown. Activities of any itinerant ministers are unrecorded. Although Roman Catholic priests had been active for many years in the south and Mormons active in the north, Protestant ministers did not arrive until after the



The Faith Lutheran Church, Tucson

Civil War. In early 1868, the Methodist minister Reverend J. L. Dyer conducted the first recorded Protestant service in Arizona. In subsequent months James Skinner, sent as a non-denominational missionary by the American Bible Society, arrived in Prescott. The Presbyterian minister Reverend William Reid, who had accompanied the governor's party across the plains, also started services in Prescott. In 1869, the Presbyterian missionary Rev. J. M. Roberts started a mission among the Navajos.

In 1870, the Methodist Episcopal Church South sent Reverend Mr. Groves to Arizona. He passed through Phoenix and proceeded to Prescott. In 1871, Reverend Franklin McKean of the same denomination arrived in Phoenix and began work there. After establishing a following in Prescott that year, the Reverend Mr. Groves went back to the Phoenix area where he alternately preached and farmed. Although he lived by his own toils, he managed to get to many communities in the area, and frequented the mining camps. The Reverend Charles Cook, of the Presbyterian Church started the Sacaton Agency also in 1870 and there established the first Indian school in Arizona among the Pimas. This same clergyman-missionary established the Tucson Indian Training School which operated for seventy-five years until its closing in 1960 by the United Presbyterian Church. In 1873, a church was formed in Phoenix and given free land. No buildings were erected, however, until 1878.

In 1874 arrived O. W. Whitaker, an Episcopal minister who only stayed a few weeks. He returned to the East because he desired to change Arizona



— Phoenix Chamber of Commerce

Central Methodist Church, Phoenix

into the New Mexico district rather than having it stay with Nevada. The first two Episcopal ministers appointed to this area, Reverend William Adams and Reverend D. B. Knickerbocker, never came. Bishop Spaulding of Colorado had what was to be the Arizona Missionary District under his charge for three years because of this absence of clergy in the area. In 1874, the Methodist minister G. H. Reeder established a three-member group in Phoenix. By 1875, the Baptists had J. C. Bristow, an unlicensed but very effective preacher, in the state. His first sermon, preached under an old cottonwood tree, is still celebrated every year by Camp Verde citizens.

No further activity occurred until 1877, when Rev. J. E. Anderson arrived in Tucson as the first Protestant minister. (Others had come to preach in the Old Pueblo as early as 1869, but none had stayed.) The first church building by Protestants was erected in 1878 in Phoenix by Presbyterians. It was an adobe structure. Reverend William Meyer established this church on one of the lots given to the Methodists in 1873. The first Phoenix Methodist Church was built the next year, 1879, by Reverend George Adams. He was the founder also of the Tucson Methodist Episcopal Church.

The 1880's saw the arrival of new denominations. The First Congregational Church of Tempe was established in 1880. Baptist churches were established in Prescott and Tucson respectively, in 1880 and 1881. St. Paul's Episcopal Church in Tombstone, Grace Episcopal in Tucson, and Trinity Presbyterian, the First Congregational, and the First Baptist churches in Tucson were established in 1881. By

1882, there were twenty-five churches active in the Arizona Territory.

The record does not say much about the frontier people who actually made up the constituency of these churches. For the most part they are nameless. The clergy and missionaries would also have been nameless were it not for the support and response which they received from the laity. The Reverend Uriah Gregory, founder of the First Baptist Church of Tucson, typified the frontier clergyman of that day at his best. Patrician of countenance and distinguished in bearing, he was tactfulness itself in winning over such recalcitrants as the lawyer from the South who "had always said that he would never hear a Northern man preach." The coming to town of the Reverend Mr. Gregory was not going to alter that position, but it did. It was not beneath Reverend Gregory's dignity to take part in the actual building of the church edifice. He laid adobe brick side by side with Mexican laborers.

The Rev. Endicott Peabody was another of the colorful and effective clergymen who worked on the frontier. A young Episcopalian missionary-priest, he came from the vicinity of Harvard to the rip-roaring boom town of Tombstone. His education in Cheltenham and Cambridge prepared him to meet what he found there, adequately if not conventionally. He felt that St. Paul's Church in Tombstone should have a neat, iron picket fence around it and made his appeal for funds at Sunday morning service. Monies collected fell far short of the necessary amount. It is reported that word of his disappointment reached the ears of the gamblers at the Crystal Palace. History was made in Tombstone while a kitty they set up for the purpose was fed for fifty hours. The perpetual poker game had a rule for those hours that every pot won with a hand above two pairs was assessed for the building of Endicott Peabody's fence. When enough had been collected, a messenger delivered the proceeds to the parish house. The realism of this clergyman, who was to go on to fame as headmaster of Groton Preparatory School in Massachusetts, was evidenced in the way he thanked the gentlemen for their generosity and went ahead and built the fence.

The Protestantism which nourished the frontier was, for the most part, a Biblical literalism with emphasis upon the individual's personal experience of God. Because of the isolation and the nature of the leadership, the Protestant who was reared in Europe had to adjust to a less churchly type of Christian ex-

pression. When a group of people, primarily women, were able to find a clergyman who would consent to stay and nurture a flock of adults and children, a Protestant community would take shape. The children were trained and adults converted. Ties with the rest of the Protestant world were weak and had to be maintained over great distances.

The circuit rider type of preachment was concerned with an individualistic salvation and a stern moralism. The frontier lived in a black and white world. The growth and development of Protestantism even in the early years of the twentieth century tended to follow this pattern. It was a reflection of the piety of the rest of the country during this period, particularly strong, perhaps, in the Territory because of the exigencies of frontier life.

Liberalizing of the Protestant message to take in social concerns and a greater solidarity of the Christian family of churches was slower developing in Arizona than "back east." With numerical growth came a strengthening of the denominational patterns, the channel through which churches today function.

Three major groupings clarify the modern identification of Protestants in the state of Arizona: The Arizona Council of Churches, the National Association of Evangelicals, and the Baptists (Southern and Conservative).

The Arizona Council of Churches representing 97,000 people makes up the largest numerical grouping in the state. The denominations represented in the Council are of the Reformation type. These include the Methodists, Episcopalians, Presbyterians, Lutherans, Congregationalists, Brethren, American Baptists, United Church of Christ, Christian, and Community churches. These denominations are represented in Phoenix and Tucson by city councils of churches, the latter established as recently as 1948.

The Arizona Council is primarily concerned with ministering to the migrants of the state. Council members are alert to social legislation and are trying to help organize local councils or units of cooperative churches in the larger communities other than the two metropolitan centers. The denominations represented work with minority groups. Institutions of the state are served through joint action in children's homes, hospitals, and jails. Cook Indian School is controlled in Phoenix by representatives of major denominations of the National Council of Churches' Home Mission Division. Work with students in the universities at Tucson and Tempe and the college at Flagstaff is done through denominational and

interdenominational sponsorship. Protestant parochial schools are maintained by Lutherans, Free Methodists, and Episcopalians.

Some of the individual congregations in the state have made large contributions through an institutional ministry. Central Methodist in Phoenix, First Methodist and Catalina Methodist in Tucson respectively are leaders in the Methodist Conference which includes Southern California. The Sunday Evening Forum held under the sponsorship of the Catalina Methodist Church ranks high in the nation among public forums. The Episcopalians have served well in the area of health through two hospitals for tuberculars — one in Phoenix and one in Tucson — both known as St. Luke's.

Opposition to legalized gambling in Arizona came from many quarters, but the churches of the Council did a great deal to defeat this in the late forties. A change in the marriage laws was brought about also by joint action, not only of the Council, but of other groups as well. The Council is giving leadership in a current struggle for a public accommodations law.

The National Association of Evangelicals is a voluntary association of forty denominations, numbering about 2,000,000 members in the theologically conservative churches of the nation. Within this framework, individual churches and clergy join together for various purposes of action. In Arizona such evangelical churches as the Nazarene, Church of God, Assembly of God, Christian Reform, Christian Missionary Alliance, Holiness, and some individual Baptist churches are members.

This association cooperated in putting through changes in the marriage laws of Arizona, a remarkable accomplishment in view of the international fame of Yuma as a quick-marriage center. The NAE has joined the Arizona Conference on Problems of Youth and Adults.

The Baptists form the third major grouping of Protestants in the state. They are divided into Southern and Conservative. The formal beginnings of the Southern Baptists in Arizona date back to 1921. Since then they have built 200 churches and seventy missions. Among the Indians, Mexicans, and Chinese they have thirty-nine mission stations. A report of 1959 gives a total of 38,487 members. They support Grand Canyon College in Phoenix.

Conservative Baptists owe much to one leader who has served the First Baptist Church of Tucson since 1918. He is the Reverend R. S. Beal. Dr. Beal



— Phoenix Chamber of Commerce

St. Francis Xavier Catholic Church, Phoenix

led thirty churches out of the Northern Baptist Convention. This group has spread beyond the borders of the state and in 1959 numbered 13,764 in Arizona. The split that led to the formation of this denomination was the fundamentalist controversy besetting Protestantism across the nation just after World War I.

There are a few groups, not numerically strong, but identifiable as Protestants although not associated with the churches previously named. Among these are the Missouri Synod of the Lutheran Church, which stands outside of the existing organizations, and the Seventh Day Adventists. The latter denomination is known in Arizona as elsewhere in the nation, for its schools, hospitals, and welfare work, as well as for religious activities. Other denominations which must be individually rather than associationally defined include the Unitarians, the Christian Scientists, and the non-Christian syncretistic groups such as the Bahais, the Religious Humanists, Unity, Ethical Culture, Rosicrucians, and others.

The Protestant denominations and groups are a significant force in the affairs of Arizona. The percentage of church affiliation in the state may be even below the national average, due to such factors as migrancy and transient population. However, the quiet work of pastors and church members furnishes "communities within the community" for many transients and newcomers to Arizona, thus widening the range of activities through which the churches make their presence felt in the life of the state.

..... *recording the present*

THE SPREAD OF NEWS AND INFORMATION IS AN old story in Arizona, which had a newspaper before it had a Territorial government, and a brief but colorful book-publishing venture before statehood. Communications in the state are provided by newspapers, radio, and television in Arizona, and they provide another and somewhat unique function. In an area where immigration from other places is so significant a factor, the agencies of spreading news have formed an image of Arizona in the minds of people who have never seen it.

Magazines and Newspapers

This was true when the first newspaper, the *Weekly Arizonian*, creaked off a Washington hand-press in the little mining town of Tubac on March 3, 1859, and it is even more true today.

A few years ago, a major manufacturer was about to be checkmated in a planned move of a plant to Arizona — along with a nucleus of key company personnel — because some of the personnel objected. Apparently their conception of the forty-eighth state embraced sand, scorpions, and little else.

Whereupon the company distributed among the personnel several hundred copies of a highly pictorial and colorful publication called *Arizona Highways*. No further persuasion was needed. The glowing page upon page of spectacular scenery convinced the employees there was much more to the Grand Canyon State than they had suspected.

The only popular magazine of general appeal produced in Arizona, *Arizona Highways* is an official organ of the State Highway Department, a description which scarcely does it justice. Many such jour-

nals tend to rest on routine reports of road construction, personnel changes, and other items of interest to highway department readers.

Arizona Highways fitted that mold until 1937, when Raymond Carlson, who is still the editor, set out to reshape it into a periodical designed to sell — principally through the use of fine color photography — the beauties of Arizona. That Mr. Carlson and George Avey, the art director, achieved this purpose is demonstrated by the record of five million copies published by 1960, with subscribers in every state and in ninety-one other nations.

Although it receives a comparatively modest state subsidy, *Arizona Highways* is for all purposes self-supporting on the income collected from circulation. There is no advertising.

The pens of editors, as well as the picks of mining men, played a role in opening the Southwest. Engineers came first, but right behind them came the early editors, with their primitive presses, pillowcases full of type, and cans of printer's ink. Both breeds of men were adventurous and fearless, but it was not adventure that brought them to the frontier. They came for gold and silver. After engineers found an outcropping or a vein of precious ore and built a camp, some printer set up shop there, because legal notices announcing the filing of claims and transfers of property were a sure source of profit.

Volume One, Number One of the *Weekly Arizonian* came off a hand press in Tubac on March 3, 1859. The four-column sheet was quite a newspaper for a border country and Tubac was quite a town. It had 400 people, including American engineers, Mexican miners and their families, and Indians.



There was no secret in the fact that the purpose of the paper was to bring the power of the printed word to bear on members of Congress, and to force the government to send out troops to protect the mining interests from Apache raiders.

William Wrightson, superintendent of the Santa Rita mines, was the publisher of the paper. He ordered a press from Cincinnati, Ohio, and had it shipped around the Horn to the port of Guaymas. From there it was hauled through the mountains and over the deserts in an ox-cart. At the same time, Wrightson imported Edward C. Cross, an eastern newspaper man, as editor, and used Charles D. Poston, "The Father of Arizona," as a contributor.

The paper had editorial vigor. A reading of the weekly issues shows that the *Arizonian* campaigned for military protection and featured news stories about Indian atrocities. It also, for a time, fought against Territorial status with considerable passion; and this editorial stand was the basis for the most colorful incident in the annals of Arizona newspapers. This was a duel between Editor Cross and Lieutenant Sylvester Mowry, owner of the Mowry mine and a leading figure in border politics.

Mowry had thrown all his energies into a campaign for Territorial status for Arizona, and was fought by Cross in the columns of the *Arizonian*. The editor finally accused Mowry of using a lie about the population of Arizona to strengthen his cause. When the paper reached Tucson and Mowry saw it, his West Point blood boiled. He swung into a saddle and galloped off for Tubac to uphold his honor. Cross accepted his challenge and chose to duel with Burnside rifles at forty paces.

Each man was to be allowed five shots. Eight shots were exchanged without effect. Cross fired and missed again. Mowry's rifle failed on his fifth shot, and the seconds agreed that he was entitled to try again. Cross stood firmly, but Mowry, saying he would not shoot an unarmed man, fired in the air and declared he was satisfied.

A very formal account of the duel appeared in the next issue of the *Arizonian* with a note of explanation of the poor marksmanship which read:

It is proper to state that at the time of the duel between Mr. Mowry and the editor of this paper a high wind, amounting almost to a gale, was blowing across the line of fire, thereby preventing accurate aim. In this case the proverb, "It's an ill wind that blows no good" is aptly illustrated.

Shortly after the duel Mowry purchased the paper and moved it to Tucson, where it appeared on August 4, 1859, as a democratic organ and a champion of Territorial status. At least five editors tried without success to run the paper before the Civil War brought its journalistic troubles to an end.

The late Estelle Lutrell, once University of Arizona librarian, remembered that by the time Arizona became a state, 200 papers had been established in sixty towns. Dozens of the papers failed and some of the towns died with them. What else could be expected in such spots as Mesilla, Harshaw, Dos Cabezas, Salome, Mineral Park, Quijota, Arizona, Pima, and Paradine? The oldest living member of the pioneer press today is the *Tombstone Epitaph*, which holds the proud record of eighty years of continuous publication.

After the Civil War stopped the press in Tucson, there was no word printed in all of Arizona until 1864, when Richard C. McCormick, Secretary of State in the new Territorial government, established the *Arizona Miner* at Fort Whipple and then at Prescott. The press used had been brought out by McCormick in one of the government wagons which transported Governor John N. Goodwin and his official party to their frontier assignment.

The *Miner* printers set type and pulled the lever of the hand press with rifles at their sides and a military guard watching for Apaches. In spite of these precautions, not all the pioneers of the Arizona press escaped. E. A. Bentley, a young editor of the *Arizona Miner*, was killed by Apaches; and William Wrightson died at the side of Gilbert W. Hopkins, one of the first University regents, when they were ambushed within 500 yards of Fort Buchanan.

It took only a small investment to start a country weekly in the seventies and eighties, and they bloomed and faded in Arizona with great frequency. If a politician thought he needed a little editorial support and couldn't get it, he started a paper. When it died at the end of the campaign, some printer would pick it up and open a shop in a location of his own choosing.

With the passing of the years, came a growing sense of responsibility to the commonwealth. Mines, railroads, political parties, and other interests continued to own papers for a long time, but the number of such papers decreased steadily. In the meantime, many a powerful editorial voice proclaimed that the semiarid lands could be conquered and made to yield a golden future. Year by year, these pioneer

editors are remembered in the Arizona Newspaper Hall of Fame, which was established under Professor Douglas D. Martin at the University of Arizona with the Arizona Newspapers Association. A growing row of copper plates on one wall of the journalism department gives the names of the men whose pens helped build the state and points briefly to their services. Included are William Wrightson, John P. Clum, J. W. (Uncle Bill) Spear, Anson H. Smith, Edward C. Cross, J. Franklin Banta, Aaron H. Hackney, George H. Kelley, and Carmen Giragi. Below the names one finds such tributes as: "He brought law and order," "His pen influenced Arizona history," "He was the father of Boulder Dam."

The 1959 directory of the Arizona Newspapers Association lists thirteen dailies and forty-three weeklies as publishing in the state. Of this number, only twelve go back to the late seventies and the eighties. These are the *Arizona Daily Star*, Tucson; *Copper Era*, Clifton; *Mohave County Miner*, Kingman; *Arizona Silver Belt*, Miami; *Phoenix Gazette*, Phoenix; *Herald Observer*, St. Johns; *Tempe News*, Tempe; *Tombstone Epitaph*, Tombstone; *Tucson Daily Citizen*, Tucson; *Williams News*, Williams; *Range News*, Willcox; *Daily Sun* and *Sentinel*, Yuma.

Daily papers are published today in Bisbee, Douglas, Flagstaff, Mesa, Nogales, Phoenix, Prescott, Tempe, Tucson, and Yuma. Weeklies are published in Ajo, Ash Fork, Benson, Bisbee, Casa Grande, Chandler, Clifton, Coolidge, Cottonwood, Eloy, Flagstaff, Florence, Gilbert, Glendale, Globe, Goodyear, Holbrook, Kingman, Miami, Parker, Phoenix, Peoria, Safford, San Manuel, Scottsdale, Show Low, Sierra Vista, St. Johns, Superior, Tombstone, Tucson, Wickenburg, Willcox, Williams, Winslow, and Yuma.

Four of the state's daily newspapers are over the 35,000 circulation mark. Their Audit Bureau of Circulation figures as published by the Arizona Newspapers Association in June, 1959, follow: *Arizona Republic*, 114,746 morning and 167,662 Sunday; *Phoenix Gazette*, 69,998 afternoon; *Tucson Daily Citizen*, 37,565, afternoon; *Arizona Daily Star*, 36,470 morning and 48,845 Sunday.

Arizona's one newspaper association was founded in 1927 and has functioned continuously since that time. The Arizona Newspaper Association has drawn the attention of the nation's newspapermen by joining with the University of Arizona in the annual presentation of the John Peter Zenger Award to the

American newspaper man who has given, during the year, the greatest service in the cause of "Freedom of the Press and the People's Right to Know."

Book Publishing

A half-century after the debut of the *Weekly Arizonian*, and still a decade before Arizona became a state, a sun-seeker named Frank Holme brought with him from Illinois a remarkably informal book-publishing operation.

Actually, Bandar Log Press had been started in a Chicago attic. The idea started with Booth Tarkington and a group of literary and artistic people including many of the day's more gilt-edged names. They took the title for an imprint from Kipling. Visitors to the garret took turns setting type, with Holme himself laboriously and skillfully whittling out woodcuts to illustrate them.

When health led him to Arizona, Holme packed Bandar Log with him. He set up shop north of Phoenix in a chicken-coop with a hand-press bought from a defunct Spanish-language weekly.

The result was a series of thin paper-backs which today might be regarded, for want of a better description, as adult comic-books. Irreverently philosophical, they followed the wry, pie-in-the-eye humor of the times, appearing in limited editions under such titles as *The Poker Rubaiyat* and *Handsome Cyril or The Messenger Boy with the Warm Feet*.

Bandar Log books sold for roughly five cents, appeared in Arizona for no more than a few years and today are collectors' rarities.

Subsequently there have been spasmodic printings within the state of a few books, most often volumes of local interest.

In a class by itself in today's publishing picture is Arizona Silhouettes, a project started by George Chambers, Tucson newspaper executive. When he began in 1950, Mr. Chambers' idea was that he would occasionally reproduce facsimiles of long out-of-print Arizoniana. He started by reprinting J. Ross Browne's *A Tour Through Arizona, 1864*, of which the first editions, brought out by Harper's, were all but non-existent.

The new edition was seized upon by collectors and history fans with such avidity that Chambers reprinted it, drafted his family into the part-time book-publishing pursuit, added a wing onto his home as a print shop and has been at it ever since.

He has wandered now and then from his original goal of sticking to reprints, though he still limits Sil-

houettes to publications about the Southwest and preferably about Arizona. There have been fourteen of them printed and more are scheduled.

As of 1960 there have been established university presses at the University of Arizona and Arizona State University. Each press produced a new, popularly written history of its institution, and for the seventy-fifth anniversary year the University of Arizona published Byrd Granger's considerably fattened version of Will Barnes' reference classic, *Arizona Place Names*.

Radio and Television

Radio and television broadcasting now is a thriving industry in Arizona, with fifty-two commercial radio stations and eight commercial TV stations on the air, as of January, 1960. The development of radio and television in the state has paralleled the technical electronic developments in the nation, and proceeded apace with the growth in population in the state.

The first broadcasts to the American public were heard in 1919, when the Westinghouse company started experimental operations. Only two years later an experimental amateur station with the call letters 6BBH went on the air in Phoenix. Arizona's current United States Senator—Barry Goldwater—was one of the three operators of the first station, which later became KDWY, now KOY, a station still on the air.

Arizona's first commercially-licensed station went on the air in Phoenix on June 21, 1922. The call letters were eventually changed to KTAR, its present identification.

The first commercial stations in Arizona were located in the two major population centers—KTAR and KOY in Phoenix, and a little later KTUC and KVOA (now KCUB) in Tucson. KTUC was opened in 1926 and KCUB in 1929.

Six more radio stations were built in Arizona before World War II. They were KSUN, Bisbee (1933); KGLU, Safford (1938); Globe (1938); and three stations which went on the air in 1940—KYUM, Yuma; KPHO, Phoenix; and KYCA, Prescott.

It was not possible to build new domestic radio or television stations during the war, but as soon as the war ended the industry mushroomed along with the state's population. Eleven new radio stations and the state's first television station went on the air in the period from 1946 to 1949, with the remainder of the radio and television stations going on the air

during the fifties.

Every section of the state now has radio service, either from local stations or nearby regional or metropolitan stations. The smallest communities in the state with local stations are Clifton, with station KCLF; Willcox, with station KWCX; Kingman, with KAAA; Show Low, with KVWM; Casa Grande, with KPIN, and Sierra Vista, with KHFH. Plans also are being made to build a station in Page, Arizona, site of the new Glen Canyon Dam.

Almost half of the state's radio stations, five of the six FM stations, and eight of the nine television stations are located in Tucson and Phoenix.

Program policies of most Arizona radio and TV stations conform to those in the nation as a whole. The most unusual variations in program policy are those practiced by the foreign-language stations in the two major cities. KIFN, Phoenix, and KEVT, Tucson, broadcast exclusively in Spanish. Several of Arizona's television stations also have weekly programs in Spanish. Another Arizona station—KCLS in Flagstaff—presents programs in the Navajo language.

Arizona's first television station, KPHO-TV at Phoenix, went on the air December 4, 1949. This station originally presented local as well as filmed programs, and belonged to all four of the national networks—CBS, NBC, ABC, and DuMont. Shortly after the debut of KPHO-TV, the Federal Communications Commission "froze" all new television applications in order to revise the channel allocations. As a result, no new stations were built in Arizona until February, 1953, when KOPO-TV (now KOLD-TV) went on the air in Tucson. During the next eight months, four more stations began operations, in the following order: KTYL-TV, Mesa, (now KVAR, Phoenix) in May; KVOA-TV, Tucson, in September; KOOL-TV, Phoenix, in October; and KIVA, in Yuma, in October. The three stations built since 1953 are KTVK, Phoenix, in March, 1955; KDWI-TV, Tucson, (now KGUN-TV) in June, 1956, and KUAT, The University of Arizona's educational television station, which aired its first program on March 8, 1959.

Although the TV transmitting stations in Arizona are limited to Phoenix, Tucson, and Yuma, almost all other areas of the state get television service by means of "translator" stations which pick up the air signals of the nine transmitting stations, amplify the picture and sound, then feed the programs by means of leased cables to the homes of subscribers.

..... *preservation of a heritage*

ARIZONA'S WEALTH IN THE WORKS OF MAN AND nature early began to demand preservation for the present and the future. Through territorial, state, and federal legislation, through individual effort and endowment, the state has gradually acquired repositories — museums, libraries, and archives for the works of man; parks, monuments, and memorials for the works of nature.

Libraries

Almost a century ago books were already a noticeable part of Arizona's cultural development. In 1862, Edward Everett Ayer, a young trooper with Carleton's California Column, was assigned guard duty at the Cerro Colorado Mine near Arivaca. There, in the small collection of books provided by the mine owner, Samuel Colt, this largely unread young man found a copy of Prescott's *History of the Conquest of Mexico*. Ayer's reading of Prescott at that sun-baked frontier outpost changed the course of his life, and he later used this inspiration to build one of the best-known collections of Americana in the country, the Ayer Collection which he bequeathed to Chicago's Newberry Library.

This was to be the pattern for many decades. Such famous aggregations of books about Arizona and the Southwest as the Munk Library, the Bancroft Library, the De Golyer, Clark, and Holliday collections have found permanent homes outside of Arizona or have been dispersed at auction.

In spite of this, Arizona has sought, often stubbornly and painfully, to do for itself what private wealth, sometimes extracted from the rock and soil of the state, failed to do for it. Today there are great

collections of Arizona materials at the University of Arizona Library and the library of the Arizona Pioneers' Historical Society in Tucson and at the Department of Library and Archives in Phoenix, as well as growing collections at Arizona State University at Tempe and at the Phoenix Public Library. Publication of the new quarterly, *Arizona and the West*, at the University of Arizona and *Arizoniana* at the Pioneers' Historical Society, reorganization of the society's collections for easier use, and establishment of a Special Collections Division in the library on the Tucson campus are evidence of the state's awareness of its riches in books and historical manuscripts and of their importance to research.

Public libraries developed slowly. In 1872 J. S. Mansfield first advertised in Tucson the opening of a circulating (rental) library. *Hinton's Hand Book to Arizona*, 1878, mentions the Prescott Library Association, "composed of leading citizens, with a public reading room containing over fifty newspapers from all points . . . and a library of 263 volumes." At the same time it refers also to a "public library in Phoenix of 250 volumes, owned by a literary association."

It was in 1882 that the Reverend Prichard rode by the still-swinging body of a Mexican hanged in a canyon near Bisbee and remarked in horror, "Something must be done to civilize these savages." The something was a collection of "well-chosen books" which he sent to Bisbee after his return to New York. These very books are still preserved in the Copper Queen Library there.

Public libraries throughout the state "began with private individuals seeking to provide for themselves

and others services of an essentially public nature. Most often the local women's clubs, or an unaffiliated group of women acting independently, were the instigators of the public library in community after community, and always, the success was such that in time it became necessary for official and public support to take over the management and continuance of these services. In many localities the club women still retain control by serving on boards and contributing voluntary work, even though municipal and county funds may be earmarked for the library's maintenance. Mining companies, too, have sometimes been generous in their support of libraries, but their interest fluctuates with market prices, and often it is withdrawn or curtailed when library facilities are most needed during times of economic stress."

In 1900 the first Carnegie library building was erected in Tucson. Others followed in Prescott in 1903, Phoenix, in 1908, and Yuma in 1921. Two of these, the library at Prescott and the building at Tucson, now much altered, still serve the book needs of their communities. In Globe the Old Dominion Mine operated a library for the public beginning in 1908. It was later taken over by the local women's club.

When the Arizona State Library Association was formed in 1926 under the leadership of Miss Estelle Lutrell, then librarian of the University of Arizona, there began a thirty-year struggle on the part of librarians, legislators, and book-loving citizens to provide equitable, tax-supported, statewide library service for Arizona. This was climaxed during the late forties and early fifties by vigorous campaigning throughout the state, as members of the Association and interested laymen sought to demonstrate new concepts of book service, to provide the political know-how through which a more dynamic pattern of library development could be achieved, and to infuse citizens with the need for a standard of library support worthy of the expanding culture and economy of the state. As a consequence, when the national Library Service Act was passed in 1956, the 1957 Arizona State Legislature was prompt in appropriating matching funds for a library extension program within the Department of Library and Archives. In the past three years, public library service in Arizona has improved hearteningly. New libraries have sprung up; older libraries have expanded their services and attracted increasing public support; the extension service bookmobile crisscrosses the state in every direction. A new awareness



— Henk Moonen

University of Arizona Library, Tucson

of the responsibility for providing this equal opportunity for all, which is the characterizing strength of modern public library operations, has sprung up in all quarters.

The beautiful Phoenix Public Library building, dedicated in 1953, the Matthews Library at Arizona State University, and new branches of the Tucson Public Library projected for construction are tangible evidence of the pride which Arizona is beginning to take in its libraries. Reverend Prichard would be pleased.

School libraries, like public libraries, have been slow to take their rightful place in our cultural scheme. Only in Phoenix is there a library supervisor for the elementary school system, for instance. However, the many new high schools built in the last decade to provide for the tremendous expansion in population, have, by and large, provided handsomely for professional library staff, quarters, and collections.

Among libraries in the state institutions of higher education, that at the University of Arizona in Tucson is the oldest and strongest. Established in 1892, shortly after the first classes were offered, it has grown steadily in support of an ever-expanding curriculum and research program. In addition to its



— Ray Brandes

The Arizona Pioneers' Historical Society houses an extensive collection of Arizona history

collection of Arizoniana it has a well organized map collection, a United States government document depository collection, and a 400-title periodical subscription list. Its main strengths are in the field of agriculture and related biological sciences, anthropology, geology, and Mexican literature.

Special libraries, confined until after World War II to a few law and medical libraries and the collections at the Department of Library and Archives, have grown significantly, usually without the painful efforts which attended the development of those libraries dependent on public recognition and support. The technical library at the U.S. Army Electronics Proving Ground at Fort Huachuca includes a dazzling array of the latest electronic equipment for the "pushbutton" retrieval of coded information. Elsewhere special collections at such places as AiResearch Manufacturing Company in Phoenix, Motorola's plant in Scottsdale, and Hughes Aircraft and Infilco at Tucson serve Arizona's special needs.

Archives and Museums

What was doubtless Arizona's first museum was established at the same time as another library, when the Society of Arizona Pioneers was organized in Tucson in 1884, to collect "all the information calculated to exhibit faithfully the antiquities and the past and present condition . . . of the territory." Its library, or reading room, was originally located in the county court house. For museum purposes the society purchased a glass-enclosed cabinet in which was displayed a rather large piece of petrified wood; these things are still in the society's possession as are several of the dozen cuspidors which were soon acquired and placed at strategic points.

By legislative action in 1897, the society officially became the Arizona Pioneers' Historical Society. Its growth was typical of most early museums and libraries; its historical collections were shunted about from pillar to post, for many years being housed in burning summer heat and winter chill in a sort of



— Henk Moonen

The Arizona State Museum — home of an outstanding collection of Southwestern archaeology

Old Curiosity Shop beneath the stands of the west stadium of the University of Arizona before the present handsome Territorial-style building was completed at Tucson in 1955.

The second oldest public museum in the state was established by the Territorial legislature under the control of the Board of Regents "for the collection and preservation of the archaeological resources, specimens of the mineral wealth and the flora and fauna of the state." Today the Arizona State Museum houses one of the most comprehensive collections in the world of archaeological materials from the American Southwest. The museum benefits greatly from close cooperation with the Department of Anthropology of the University of Arizona.

Byron Cummings, the first director, recalled that when he was "invited" in 1915 to preside over the "collection," he was taken to an unfinished alcove in the Agriculture Building, then still under construction. On the floor was "a pile of stone implements, a jumble of some ethnological material and several cases of bird skins" which had just been taken out of storage where they had been put because there was no room on the campus to display them.

Under Cumming's direction the collections expanded along with the archaeological works he

pioneered and were moved in 1930 to rooms under the west stadium. Finally in 1936, the museum occupied its own building at the main entrance to the University of Arizona campus where its handsomely mounted displays show Arizonans the richness of their prehistoric past and the wealth of their natural resources.

Another campus institution for many years in Tucson was an enormous outdoor birdcage in which a wide variety of birds lived under almost natural conditions. The birdcage unfortunately disappeared when local residents in the fast-growing neighborhood complained of the early morning noise.

Special libraries are often integral parts of museums though they are generally assembled for the use of the staff and are rarely seen by visitors. An excellent one is housed at one of the state's finest museums, the Museum of Northern Arizona, set in a pine grove outside the city of Flagstaff at the foot of the soaring San Francisco Peaks.

These majestic mountains, home of the Hopi gods, are framed in a huge picture window as the visitor steps inside the door. The museum appropriately is largely devoted to the ethnology and archaeology of the region with strong emphasis on the Hopi. A privately endowed institution, founded

in 1929 by Dr. Harold S. Colton, it has become one of the outstanding research institutions in the West, with a staff which is carrying on significant work behind the scenes to give modern man a better understanding of the world around him.

The Phoenix area has five museums. The Heard Museum of Anthropology and Primitive Arts was also established in 1929 by Mr. and Mrs. Dwight B. Heard. Its collections are relatively small, but the high standards set by the late Mrs. Heard are reflected in the superb examples of aboriginal artifacts collected from many parts of the world. The past decade has seen steady growth and expansion. A junior museum and adult arts and crafts classes were inaugurated in 1958; a new wing houses a colorful display of the daily life of the Navajo. Plans for a research program are now being formulated by the trustees and a traveling exhibit department is being built up for the elementary schools of Phoenix.

The newest and largest museum in Arizona is the \$500,000 Phoenix Art Museum opened with a gala champagne party in November, 1959. It will eventually be expanded by a 35,000 square foot addition that will unite it with the Public Library and the Phoenix Little Theater into an integrated, block-size civic center.

The two-story windowless building houses two main galleries on the lower floor, and incorporates the newest museum lighting devices, blending fluorescent and incandescent light to eliminate the problem of annoying glare.

Currently under construction at Tempe is a second art museum for the Valley of the Sun which will house Arizona State University's outstanding collection of American art. This collection presents a panorama of recent American painting including fine examples of the work of many of the best known artists of the past fifty years. In addition a collection of Renaissance and seventeenth century European paintings has been donated by Lewis Ruskin of Scottsdale.

On the eastern edge of the city of Phoenix is the unique open-air museum of Pueblo Grande. It is a partially excavated archaeological site, a prehistoric Indian community that has been weather-proofed and opened to visitors via guided tours and recorded lectures. A small museum building houses Hohokam material culture items and helps illustrate the story of prehistoric irrigation on the very spot where modern irrigation has once more brought the valley back to green fertility. The project is operated as a Division

of Archaeology within the Phoenix Parks and Recreation Department.

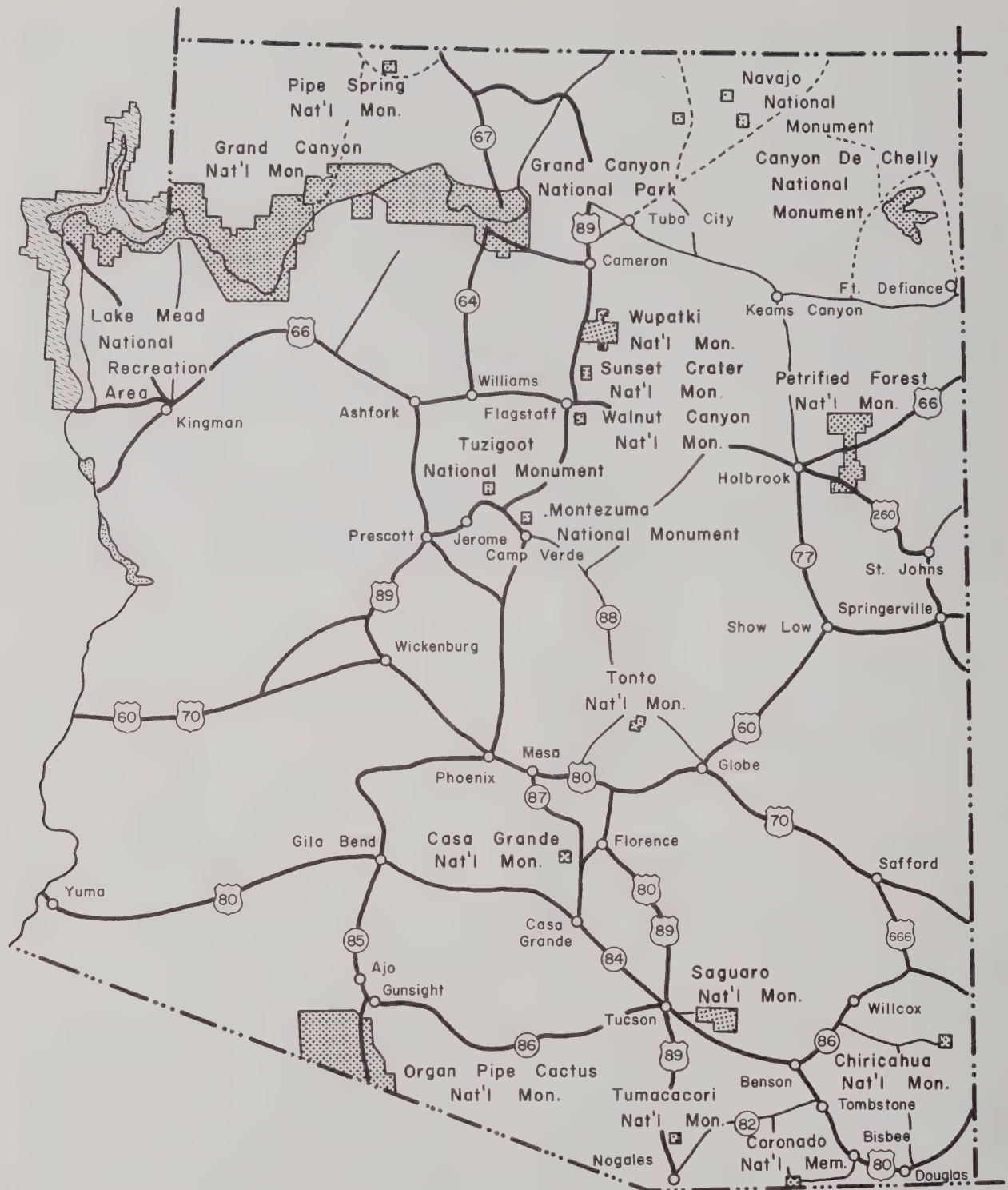
Arizona has been referred to as a "natural anthropological laboratory." Much anthropological and natural history material is displayed in small museums — some of which are even found in the units of the national park system which are in a very real sense museums themselves.

The fifth museum is the Arizona Museum devoted to pioneer Arizona history. The Little Emma, the diminutive locomotive which hauled ore cars between Morenci and Clifton almost 75 years ago, rests outside and excites interest. Inside, unfortunately, the many rare and interesting items suffer from improper curatorial care. A house cleaning and a face-lifting would bring these valuable materials into proper focus.

A major art collection of the state is housed in the new two-story gallery building in the Fine Arts Center on the University of Arizona campus. The Tucson Fine Arts Association maintains another museum in a remodelled mansion in a once-fashionable residential area dubbed "snob hollow." It has no permanent collections, but during the winter season presents a well-rounded series of traveling exhibits and exhibits of works by local artists.

A small but excellent archaeological museum is located at Dripping Springs, east of Tucson, and supported by the Amerind Foundation established by William Shirley Fulton for the promotion of archaeological research in the Southwest. The foundation has carried out important excavations in the San Pedro and Santa Cruz valleys, which have revealed much of the ancient life of the southeastern section of the state. Under the direction of archaeologist Charles Di Peso, it is presently engaged in exciting excavations at Casas Grandes in Chihuahua, Mexico, in collaboration with the Mexican government.

On the west slope of the Tucson Mountains overlooking the broad sweep of the Avra Valley and the jutting peak of Baboquivari, sacred mountain of the Papagos, is the fascinating Arizona-Sonora Desert Museum. A unique combination of indoor and outdoor exhibits tells the story of the plant and animal ecology of the desert life zone. The visitor is entranced by the exhibits of cacti, desert animals and desert fish, the wonderful underground museum where life beneath the desert floor is exhibited, and the extensive and absorbing Water Street, U.S.A. where the story of that life-giving resource and its relation to the Southwest is thoroughly explored.



National Parks and Monuments in Arizona — maintained by the National Park Service — help to preserve some of the world's most spectacular scenic views, important archaeological and historical landmarks, and the unusual vegetation and wildlife peculiar to the region



— Esther Henderson

Casa Grande National Monument near Coolidge — home of prehistoric Hohokam and Salado Indians

Parks, Monuments and Memorials

By the turn of the century Arizona, only 35 years away from the Civil War which had seen her population almost vanish, was developing its cultural resources not only in libraries, museums, universities, and colleges but also in natural historical and recreational sites.

One year before the Territorial legislature had acted to establish, on paper at least, an archaeological museum, the Congress of the United States, acting on permissive legislation passed in 1889, authorized reservation of lands surrounding the four-story, 600 year-old combination watchtower and community dwelling known as Casa Grande. This created Arizona's first National Monument — though it was not officially so designated until 1918. The Casa Grande, built of packed earth by prehistoric Indian farmers, is the only surviving example of such structures which once dotted the Salt River Valley.

It often surprises Arizonans accustomed to superlatives about their state, to discover that it possesses

yet another; more National Monuments than any other state. Besides Grand Canyon National Park, there are two National Recreation Areas, one of which (Glen Canyon) is not yet functional, one National Memorial, and sixteen National Monuments. These twenty areas comprise about 2 percent of the state's 72,688,000 acres, and in 1959 they attracted more than six and one-half million visitors.

Long before Congress established the National Park Service in 1916, a number of Arizona's natural and historic wonders had been set aside under the care of other agencies. Grand Canyon was created as a National Monument by President Theodore Roosevelt in 1908, under the administration of the Forest Service, but it was not made a national park until 1919.

Grand Canyon, one of the wonders of the world, possesses so many scientific and scenic superlatives that it almost defies description. Whole books have been devoted to the Canyon and the river which created it and more are sure to be written. Most



— Chuck Abbott

The ruins at Wupatki National Monument — in the high plateau country north of Flagstaff

visitors get only a brief, two-dimensional view so easily available at the rim. Really to see the park requires several days following trails, seeing museum exhibits, listening to ranger talks, and especially going down into the very vitals of the chasm where the muddy, turbulent river continues to writhe and roar and scour its way ever deeper into the earth.

To the west of the park is the Grand Canyon National Monument, somewhat inaccessible and infrequently visited but almost equally awesome. At one spot, Toroweap Point, there is a 3,000 foot view straight into the Colorado, a view not possible in the park.

Lake Mead National Recreation Area, partly in Arizona, partly in Nevada, lies directly to the west. It includes Lake Mead and Lake Mohave, formed by the river and restrained by Hoover and Davis dams. Here, in the searing desert, fishermen catch fabulously big trout. The water in the Colorado, released from the bottom of the lake behind the dams is cold and makes excellent trout water.

One group of monuments is primarily of archaeological interest. These include besides Casa Grande, Montezuma Castle, Tonto National Monument, Tuzigoot, Walnut Canyon, Wupatki, and Navajo National Monument. Tonto contains a group of cliff

dwellings overlooking the present Roosevelt Lake which were occupied during the fourteenth century by the Salado Indians, possibly as a defensive site. Life must have been rugged for the Salado farmers. The nearest dependable spring was half a mile from the dwellings while their fields were two to four miles away on the Salt River flood plain.

Northwest of Tonto is the lush Verde River Valley which was the home of agricultural Indians from at least one thousand years ago to as recently as the early fifteenth century. Toward the end of the period there seems to have been much competition for irrigable land and defensive structures were essential. Towns or pueblos were built on hilltops, as at Tuzigoot, or where suitable in cliff dwellings like Montezuma Castle.

Tuzigoot was strategically located on the end of a limestone ridge near the river and adjacent to farming land. Montezuma was high in a limestone cliff on Beaver Creek and close to rich farm land. It is a five-story, twenty-room structure, about 90 percent intact and original. However it rests so precariously on soft, friable, much-eroded stone that it was necessary several years ago to discontinue taking visitors through the building.

Farther north near Flagstaff is Walnut Canyon,



— Esther Henderson

Tuzigoot National Monument — built by prehistoric Sinagua Indians on a hill overlooking the Verde River

known for the beauty of its heavily vegetated canyon slopes and hundreds of small cliff dwellings built in its natural caves and occupied by the Sinagua Indians, mainly during the eleventh to thirteenth centuries. Farming was made possible in this area by the eruption in 1064 of the volcanic field in the San Francisco Peak area which created Sunset Crater, a 1,000-foot volcanic cinder cone which blew its top and blanketed the land with volcanic ash for many miles around. Indians, frightened away by the eruption, came back later to find the cinders and ash had made a fine moisture-retaining mulch. Word spread rapidly, and by A.D. 1100 an estimated 4,000 Indians had come to the area.

At Wupatki National Monument, a few miles north of Sunset Crater, are hundreds of homesites which were built late in the twelfth and early in the thirteenth centuries. The excavated and partially reconstructed ruin of Wupatki shows the visitor that a highly developed agricultural community existed here. Drought conditions and probable drifting of moisture-conserving cinder into dunes caused gradual depopulation in the thirteenth century. The entire Wupatki Basin was abandoned by A.D. 1300.

Nearly one hundred miles northeast, near the Utah border, lies Navajo National Monument including the spectacular Keet Seel, the largest cliff ruin in Arizona, and two other large and well-preserved cliff dwellings, Betatakin and Inscription House. These were also deserted about the time the Wupatki area was abandoned.

In the heart of the Navajo Reservation is Canyon de Chelly National Monument, consisting of two deep canyons with towering, strangely wind-eroded, brilliant red rock walls — de Chelly and del Muerto. These canyons also sheltered Basketmaker and Pueblo Indians until about the year 1300 as they later sheltered the Navajo. However, the monument today is probably chiefly interesting to the visitor for its rare and imposing natural beauty. It can be viewed from points on the rim, and arrangements may be made for trips along the canyon floor in a specially equipped car.

Also in northern Arizona is the most spectacular display of petrified wood in the world, adjacent to a colorful portion of the Painted Desert. Both are included in Petrified Forest National Monument. There are six "forests," formed by silica, picked up

by ground water and carried into cell tissues of the wood to form the present petrified logs from trees which grew millions of years ago. Iron and manganese oxides were chiefly responsible for the varied coloring, both of the trees and the surrounding desert.

In the volcanic field northeast of Flagstaff, Sunset Crater has been set aside as a National Monument. Its black, red-tipped cone is best seen in the afternoon as the sun begins to descend behind the San Francisco Peaks.

In the southern deserts, two national monuments have been established to protect and preserve the characteristic desert life for which this region is known over the world. Saguaro, near Tucson, includes what are probably the biggest specimens of the giant cactus in the United States. While the saguaro is the most spectacular feature, the entire plant community at lower elevations is picturesque. An astonishing variety of wild animals and birds also frequent the area.

Farther west, adjoining a lengthy strip of Sonora's northern boundary, Organ Pipe Cactus National Monument contains more than 500 square miles of Sonoran desert. Here, in the wild beauty of desert mountains, vast stretches of surrounding *bajadas* (outwash plains) and a variety of grotesque vegetation, is the only large group of organ pipe cactus in the United States. Loop roads and trails offer good opportunities to see the desert as a place populated with living things.

East across the state is Chiricahua National Monument, a sort of miniature opposite of the Grand Canyon. Instead of dramatizing what erosive forces have gouged out, nature has left here innumerable bizarre-looking rock forms that erosion has left standing up, pointing away from the earth instead of into it. This wonderland of rocks occurs high in a forested range, a mountain island in a desert sea. The mountain range was the part-time home of the Chiricahua Apaches who, under the brilliant leadership of Cochise, for twelve years matched the strategy of the U.S. Army, forcing the establishment of Fort Bowie on the northern flank of the mountains to protect the overland stage route.

The two historical monuments, Tumacácori and Pipe Springs, are almost a state's width apart. Tumacácori, some twenty miles north of Nogales, is the ruin of a typical Franciscan mission church of 150 years ago. It was built at the peak point of missionary achievement on the northern frontier of what was then New Spain. The shell of the building is well

preserved and the fine museum explains vividly the missionary movement in the Arizona-Sonora region and the daily life of the padres. Its charming patio where gnarled olive trees surround a terraced fountain is one of the most delightful oases in southern Arizona.

Pipe Spring National Monument in the isolated Arizona Strip north of the Colorado River is named for a shooting exploit of Jacob Hamblin who led the first group of White men to visit the spring. The Mormon fort built there for protection against Navajos and Paiutes in the 1860's is an expression of the courage, foresight, and faith of the pioneers in general and the Mormons in particular.

Also part of the historical picture is Coronado National Memorial astride the southern tip of the Huachuca Mountains on the Mexican border. After a short climb from the parking area at Montezuma Pass the visitor reaches the top of Coronado Peak, 6,880 feet above sea level. To the south and the west stretches the majestic panorama of blue mountain and grassed valley through which the expedition of Coronado is believed to have passed leading the first White men into the Southwest.

Today Arizona is in grave danger of losing its archaeological heritage. In the Tucson Basin alone, with its known 300 village sites of prehistory as inventoried in the archaeological survey file of the Arizona State Museum, only one will surely have been preserved a few decades hence. This is the University Indian Ruin at the junction of the Pantano and Rillito drainages. This ruin is being "banked" for future development by the University of Arizona. Similar efforts to record information on other sites in the northern half of Arizona are being made by the staff of the Museum of Northern Arizona at Flagstaff.

The construction of superhighways, reservoirs, the reclamation of the desert for agriculture, and metropolitan and industrial expansion have already obliterated many ruins. Many more will suffer the same fate. A fact not readily appreciated is that our archaeological resources are exhaustible. The day will come when the collections in the museums and the national monuments, preserved by the forward-looking planners of municipal, state, and federal agencies, will be the only remaining evidence of the prehistory of the state. The tragedy is that the loss is national in scope.

To cope with this problem, an independent committee was formed in 1945, known as the Committee for the Recovery of Archaeological Remains, whose



— Chuck Abbott

Anasazi cliff dwellings in the red sandstone walls of Canyon de Chelly National Monument

membership is made up of representatives of the Society for American Archaeology, the American Anthropological Association, and the American Council of Learned Societies. The support given this committee by the Smithsonian Institution and the National Park Service, as coordinating agencies, led to the development of the Inter-Agency Archaeological Salvage Program. This program now has about sixty cooperating federal, state, and other agencies, drawing funds from federal appropriations, as well as from state, local, and private sources. In the first twelve years of its history, this program has surveyed 310 reservoir areas in forty-two states, including Arizona, for archaeological, historical, and paleontological remains. More than 9,000 archaeological sites have been inventoried, excavations have been undertaken in sixty-nine reservoir areas in thirty-one states, and over 300 publications have resulted. In addition to this impressive, though far from sufficient effort, a number of states have worked out effective arrangements with state and federal highway agencies to salvage the data and material from ruins doomed to destruction by highway building.

Private industry, notably gas distributing companies, has cooperated most commendably in employing archaeologists, where necessary, to survey and dig in pipeline rights-of-way.

The University of Arizona through the Arizona State Museum, and the Museum of Northern Arizona at Flagstaff are working diligently to do their share in the salvage program. Cooperative arrangements with National Park Service and the Arizona State Highway Commission are in effect, and other steps are planned.

But it is not just prehistoric sites that have suffered from neglect and willful destruction. Many of Arizona's most historic sites have also disappeared. To aid in preserving Arizona's heritage, the Arizona legislature in 1957 created the State Park Board. Under the directorship of Dennis McCarthy three sites — Tubac, the Tombstone Courthouse, and the Yuma Territorial Prison — have already been designated as state parks.

Private individuals are at work too. Under the auspices of the Arizona Pioneers' Historical Society, the Committee for the Preservation and Restoration



— Chuck Abbott

The blue waters of Montezuma Well, Montezuma National Monument, are fed by permanent springs

of Historical Sites in Arizona has recently been formed. This committee — whose representation is state-wide — has as its goal the surveying and marking of historic sites, as well as the restoration of Fort Lowell and the Old Adobe Patio in Tucson.

All such efforts will aid in preserving Arizona's past. But no effective way has yet been found to forestall the losses due to urban and agricultural

expansion, nor the destruction wrought by the private citizen, wittingly or unwittingly, who in the face of federal and state antiquities laws, continues to vandalize ruins and historic sites for personal satisfaction and gain. Needed most desperately is an enlightened public that recognizes the value in understanding and in preserving the relics, records, and reminders of America's and, locally, Arizona's past.



..... *research and the future*

THE FUTURE OF ARIZONA, LIKE THAT OF THE rest of the world, lies in research. In its broadest aspect, research is the basis for progress in every area of human society in every part of the world. Man must continue to investigate, to observe, and to interpret his findings. Knowledge from such activities helps man to minimize illness and pain, augment the production and distribution of food, increase his control over himself, his society, and his environment, and to improve international understanding.

One of the most important advantages afforded by Arizona's environment is the opportunity for studying problems related to living in an arid region. Such problems and their solutions have significance far beyond the borders of the state and nation, and give Arizonans an opportunity to contribute valuable knowledge to the other arid regions of the world.

Among problems of living in an arid region are those concerning the welfare of the native and immigrant populations, the development of agriculture through controlled use of water, the exploitation of mineral resources, and the utilization of special features of the area for scientific study.

Before World War II, with the development of agricultural and mineral resources well under way, and with the continuing growth of the population and educational and research institutions, Arizonans already had many reasons to be proud. Since the war, with a new day dawning for the native Indian peoples, with a large growth of population, and with the increasing industrialization and general diversification of the economy, Arizona has marked a path of progress unequalled by any other arid region.

Predictions indicate a future growth in population

in Arizona greater than that of the past fifteen years; thus, it is estimated that by 1975 the population will have increased to approximately 2,000,000. The primary cause of this growth is due to the desire of many people to live under the conditions of dryness, sunshine, and warmth characteristic of Arizona. It is by means of new knowledge gained through research that new means of earning a living will be discovered for Arizona's expanding population.

Arizona needs research to increase the availability of water, and to bring about more efficient utilization of already existent water; to increase the efficiency of usage of its limited arable lands; to devise better means of capitalizing upon its known mineral resources, and of finding additional reserves; to discover and develop manufacturing processes and industries suited to Arizona's location and environment; and to make living in Arizona even more advantageous and enjoyable.

Research moves swiftly today. Complex mathematical computations that once required months or years of patient individual effort are the work of seconds for electronic computing equipment. Large computers are housed at the General Electric Computer Center at Arizona State University, at Fort Huachuca, and at the Numerical Analysis Laboratory at the University of Arizona. The availability of these computers has contributed much to the development of research. The TRIGO Nuclear Reactor at the University of Arizona is capable of continuous operation at thirty kilowatts with fractional pulses to 200 megawatts.

In Arizona, to mention only a few developments, arid lands research has found a compatible home; the

study of rainfall, upper atmospheric changes, and cloud modification is the special province of atmospheric research, particularly at the Institute of Atmospheric Physics at the University of Arizona. As man probes farther into the interstellar dark of outer space, the Lowell and the U.S. Naval observatories at Flagstaff, the Steward Observatory at the University of Arizona, and the Kitt Peak National Observatory forty miles southwest of Tucson are important centers of research. At Portal, in continuation of the contributions of a long and distinguished line of private research foundations in Arizona, the Southwestern Research Station of the American Museum of Natural History offers biologists and other scientists a unique geographical situation which affords opportunity for study in five of the life zones.

Arizona has developed its own Academy of Science. Under the spread of this intellectual tent, many men and women of Arizona have joined in the search for solutions to problems of survival and better living. The U. S. Army Electronic Proving Ground at Fort Huachuca is a major installation for military and communications research. The Association for Applied Solar Energy and the two universities work to harness the power of the sun for man's use. Cotton undergoes scientific testing continually by University of Arizona scientists and cooperating scientists of the United States Department of Agriculture at the Cotton Research Center near Phoenix and in the laboratory of the Agricultural Experiment Station in Tucson where research has produced the leading varieties of high-quality fibers grown in the world today. Throughout Arizona many other state and federal agencies continue long records of important research activity.

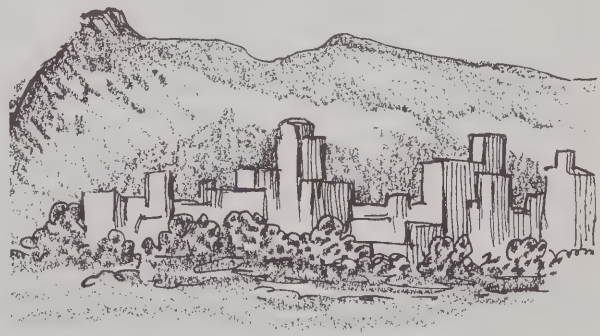
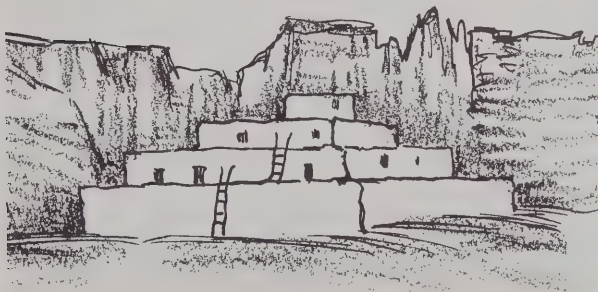
Extensive research programs are also carried on by private industries throughout the state, including, among others, those of the mining companies, work

in the Phoenix area in solid state conductors by Motorola, in computer technology by General Electric, and in the field of components for electronics equipment by Sperry-Rand and AiResearch, and in the Tucson area, work in missile research by Hughes Aircraft, in the filtration problems of nations by Inflico, and in military communications by the Radio Corporation of America.

Throughout a thousand years of history, the main functions of the universities of Europe and the Americas have been to impart to each rising generation the accumulated knowledge and wisdom of the past, and to seek continually through research new knowledge for the benefit of mankind. This tradition has been and continues to be a guiding principle in the development of higher education in Arizona.

Founded in 1885, the University of Arizona throughout the intervening years has served as the center of research for the state. Three-quarters of a century ago the need for new knowledge for the development of the agricultural resources of the Territory was so great that the Agricultural Experiment Station was organized even before the University opened its doors to students. The subsequent addition of fifteen research divisions at the University of Arizona has been in response to the developing needs and the special opportunities afforded by the state. Nine of these divisions have been established since World War II. Over and above regularly budgeted research funds, research grants and contracts from federal agencies, private foundations, corporations, and individuals amounted to \$318,262 in 1954-55, rose to \$2.25 million in 1958-59, and reached \$3.46 million in 1959-60.

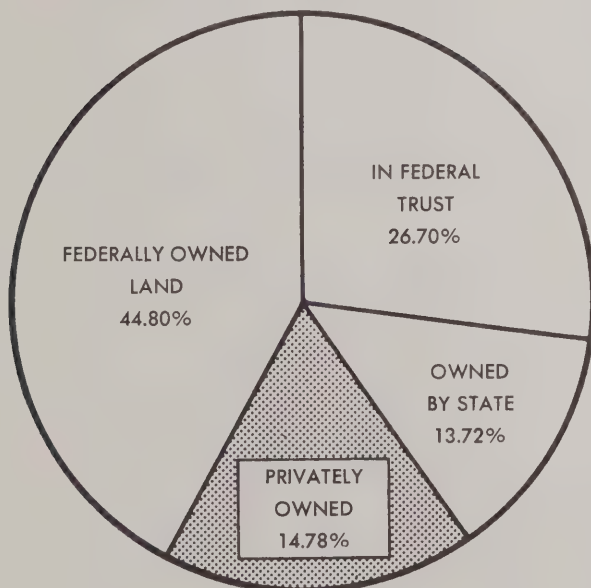
Thus, Arizona is once again a frontier — this time a frontier where new knowledge gained through research points to a new day of technological progress in many fields, not only for Arizona, but also for other arid regions of the nation and the world.





..... *appendix A - statistical tables**

WHO OWNS ARIZONA?



Total Acreage 72,688,000

**Compiled with the aid
of the Valley National Bank*

MAJOR SOURCES OF ARIZONA INCOME BY YEARS

Year	Crops	Livestock	Manufacturing	Mining	Tourists
1944	\$ 80,388,000	\$ 45,167,000	\$ 94,000,000	\$113,095,000	\$ 25,000,000
1945	89,648,000	52,081,000	105,000,000	95,963,000	40,000,000
1946	102,955,000	60,273,000	86,000,000	114,986,000	60,000,000
1947	112,192,000	75,860,000	117,000,000	182,753,000	75,000,000
1948	143,065,000	85,894,000	136,000,000	196,208,000	90,000,000
1949	163,918,000	70,481,000	129,000,000	177,894,000	100,000,000
1950	184,654,000	94,211,000	142,000,000	201,034,000	100,000,000
1951	229,031,000	130,938,000	214,000,000	235,289,000	120,000,000
1952	267,012,000	116,932,000	275,000,000	220,686,000	135,000,000
1953	320,189,000	99,783,000	320,000,000	242,572,000	150,000,000
1954	269,550,000	94,776,000	300,000,000	239,974,000	160,000,000
1955	242,842,000	100,455,000	350,000,000	351,631,000	180,000,000
1956	264,688,000	108,739,000	400,000,000	484,959,000	200,000,000
1957	252,701,000	121,880,000	460,000,000	372,641,000	225,000,000
1958	271,800,000	163,782,000	490,000,000	314,520,000	250,000,000
1959	237,345,000	166,933,000	550,000,000	326,316,000	280,000,000

INCOME GROWTH

Rank	State	1948	1958	% Gain
1.	Florida	\$ 3,053,000,000	\$ 8,334,000,000	173.0
2.	ARIZONA	857,000,000	2,203,000,000	157.1
3.	Nevada	273,000,000	686,000,000	151.3
4.	New Mexico	649,000,000	1,548,000,000	138.5
5.	Delaware	550,000,000	1,253,000,000	127.8
6.	California	17,610,000,000	36,692,000,000	108.4
7.	Colorado	1,760,000,000	3,503,000,000	99.0
8.	Maryland	3,309,000,000	6,566,000,000	98.4
9.	Utah	796,000,000	1,516,000,000	90.5
10.	Louisiana	2,601,000,000	4,901,000,000	88.4

NON-FERROUS MINERAL PRODUCTION

Rank	State	1957	1958	% of U.S.
1.	ARIZONA	\$332,082,000	\$273,398,000	36.5
2.	Utah	179,067,000	131,270,000	17.5
3.	Montana	75,123,000	60,787,000	8.1
4.	Nevada	52,346,000	43,300,000	5.8
5.	Idaho	52,598,000	41,821,000	5.6
6.	New Mexico	47,975,000	32,419,000	4.3
7.	Missouri	38,773,000	28,296,000	3.8
8.	South Dakota	20,006,000	20,117,000	2.7
9.	Colorado	25,449,000	17,479,000	2.3
10.	Tennessee	19,042,000	16,758,000	2.2

AGRICULTURAL INCOME

Rank	State	1948	1958	% Gain
1.	Florida	\$ 335,300,000	\$ 688,900,000	105.5
2.	ARIZONA	228,900,000	435,600,000	90.2
3.	Georgia	519,500,000	720,700,000	38.7
4.	California	2,164,100,000	2,829,500,000	30.7
5.	North Carolina	792,000,000	1,010,700,000	27.6
6.	Nebraska	1,025,800,000	1,247,700,000	21.6
7.	Texas	1,954,700,000	2,372,600,000	21.4
8.	Iowa	2,136,700,000	2,560,000,000	19.8
9.	New Mexico	188,700,000	225,300,000	19.4
10.	Delaware	98,700,000	115,000,000	16.6

ANNUAL CROP AND LIVESTOCK INCOME IN ARIZONA

(Source: *Arizona Agriculture*, Agricultural Extension Service, University of Arizona)

(In millions of dollars)

Year	Agricultural Crops	Livestock and Animal Products	Federal Govt. Payments	Totals
1947	116.3	62.0	1.7	180.0
1948	147.5	70.8	.7	219.0
1949	166.7	67.0	1.3	235.0
1950	194.0	77.3	1.7	273.0
1951	288.0	89.3	1.7	379.0
1952	297.9	*	*	410.0
1953	295.0	*	*	384.0
1954	281.0	*	*	380.0
1955	239.0	94.5	1.5	335.0
1956	275.0	103.0	2.0	380.0
1957	252.0	118.1	7.9	378.0
1958	279.4	137.6	4.0	421.0
1959	265.1	136.7	2.6	404.4

*Separate figures for livestock and animal products and federal government payments are unavailable. Combined figures for both categories were 112.1 in 1952, 89.0 in 1953, and 99.0 in 1954.

BUILDING PERMITS ISSUED IN LEADING CITIES

(Valuation of New Construction —
City Limits Only)

Year	Phoenix	Tucson
1949	\$12,094,168	\$ 9,228,499
1950	15,700,161	9,064,148
1951	20,696,272	6,621,266
1952	13,182,472	6,720,127
1953	16,296,491	7,870,235
1954	18,144,534	8,131,921
1955	22,059,200	11,995,680
1956	35,415,918	23,949,316
1957	26,994,876	17,692,088
1958	47,576,200	13,404,857
1959	89,553,786	43,531,164

CONSTRUCTION EXPENDITURES IN ARIZONA

(As Estimated By Valley National Bank)

Year	Dollar Volume
1949	\$110,000,000
1950	125,000,000
1951	175,000,000
1952	215,000,000
1953	275,000,000
1954	290,000,000
1955	325,000,000
1956	350,000,000
1957	425,000,000
1958	500,000,000
1959	560,000,000

TAXES COLLECTED IN ARIZONA

Fiscal Year	Federal Taxes	State & Local Taxes	Total Taxes	Arizona Income (*)	% Of Income Pd. In Taxes
1947-48	\$ 83,813,698	\$ 67,724,936	\$151,538,634	\$ 749,000,000	20
1948-49	82,128,232	74,849,823	156,978,055	839,000,000	19
1949-50	74,822,095	78,813,105	153,635,200	889,000,000	17
1950-51	106,356,762	96,652,039	203,008,801	978,000,000	21
1951-52	142,525,946	102,545,226	245,071,172	1,227,000,000	20
1952-53	165,840,697	110,266,196	276,106,893	1,395,000,000	20
1953-54	163,109,922	121,486,471	284,596,393	1,441,000,000	20
1954-55	167,739,000	129,114,065	296,853,065	1,495,000,000	20
1955-56	184,565,000	163,964,752	338,529,752	1,633,000,000	21
1956-57	212,601,000	169,776,766	382,377,766	1,854,000,000	21
1957-58	234,881,104	190,496,030	425,377,134	2,019,000,000	21
1958-59	266,127,317	213,083,132	479,210,449	2,203,000,000	22
1959-60	309,604,793	229,081,344	538,686,137	2,450,000,000	22

(*) Income on Calendar Year Basis

SUMMARY OF STATE AND LOCAL TAXES

Fiscal Year	State Property Tax	City & County Prop. Taxes	School Dist. Prop. Taxes	General Sales Taxes	Motor Fuel Taxes
1947-48	\$ 5,694,950	\$ 6,584,800	\$11,823,983	\$16,782,527	\$ 8,974,748
1948-49	— 0 —	11,475,123	17,615,230	17,396,653	9,581,223
1949-50	4,763,966	10,780,807	20,817,526	16,147,407	10,297,242
1950-51	11,721,403	10,711,983	20,115,389	20,389,020	11,723,851
1951-52	7,866,724	11,044,868	23,023,591	22,246,253	13,453,567
1952-53	7,908,953	12,159,223	25,959,650	24,379,367	15,083,515
1953-54	8,996,210	14,218,150	31,126,072	24,913,040	15,537,993
1954-55	7,579,100	15,961,779	34,144,819	27,225,278	16,494,682
1955-56	13,126,664	20,049,231	35,779,510	31,872,316	18,903,782
1956-57	12,381,461	19,044,879	44,137,060	34,704,505	19,700,797
1957-58	16,930,949	23,450,465	54,360,687	36,151,013	21,444,921
1958-59	20,073,176	23,940,851	61,213,189	41,545,068	21,663,456
1959-60	24,752,437	27,935,966	59,611,018	43,509,552	23,040,024

Fiscal Year	Income Taxes	Licenses, Fees & Permits	Luxury Taxes	Miscellaneous Taxes	Total State & Local Taxes
1947-48	\$ 8,243,930	\$ 3,710,859	\$3,674,885	\$ 2,234,254	\$ 67,724,936
1948-49	8,279,103	4,351,172	3,802,149	2,349,170	74,849,823
1949-50	5,640,501	4,381,562	3,745,404	2,238,690	78,813,105
1950-51	9,761,976	5,621,080	4,077,563	2,529,774	96,652,039
1951-52	11,312,429	6,196,739	4,337,883	3,063,172	102,545,226
1952-53	9,056,014	7,217,307	4,760,627	3,741,540	110,266,196
1953-54	10,238,841	7,591,576	4,643,471	4,221,118	121,486,471
1954-55	11,102,907	7,674,057	4,789,485	4,141,958	129,114,065
1955-56	14,664,072	9,501,435	5,118,743	4,948,999	153,964,752
1956-57	14,835,713	10,401,974	5,513,541	9,056,836	169,776,766
1957-58	11,628,276	11,112,031	5,912,286	9,505,402	190,496,030
1958-59	14,382,465	12,955,080	6,493,728	10,816,119	213,083,132
1959-60	16,663,597	14,243,600	7,086,351	12,238,799	229,081,344

POPULATION FIGURES BY U.S. CENSUS BUREAU

	1910	1920	1930	1940	1950	April, 1960
STATE TOTAL	204,354	334,162	435,523	499,261	749,587	1,288,433
The Counties						
Apache	9,196	13,196	17,765	24,095	27,767	30,008
Cochise	34,591	46,465	40,998	34,627	31,488	54,772
Coconino	8,130	9,982	14,064	18,770	23,910	41,765
Gila	16,348	25,678	31,016	23,867	24,158	25,167
Graham	23,999	10,148	10,373	12,113	12,985	13,824
Greenlee	—	15,362	9,886	8,698	12,805	11,467
Maricopa	34,488	89,576	150,970	186,193	331,770	657,688
Mohave	3,773	5,259	5,572	8,591	8,510	7,719
Navajo	11,471	16,077	21,202	25,309	29,446	37,629
Pima	22,818	34,680	55,676	72,838	141,216	261,428
Pinal	9,045	16,130	22,031	28,841	43,191	61,702
Santa Cruz	6,766	12,689	9,684	9,482	9,344	10,762
Yavapai	15,996	24,016	28,470	26,511	24,991	28,510
Yuma	7,733	14,904	17,816	19,326	28,006	45,992
Leading Cities						
Phoenix	11,134	29,053	48,118	65,414	106,818	434,277
Tucson	13,193	20,292	32,506	35,752	45,454	210,016

POPULATION GROWTH OF MAJOR CITIES

As of Jan. 1	Phoenix (City Limits)	Greater Phoenix	Tucson (City Limits)	Greater Tucson
1940 (Apr.)	65,414	120,000	35,752	64,000
1941	69,000	124,000	36,000	66,000
1942	75,000	132,000	36,000	68,000
1943	79,000	140,000	38,000	76,000
1944	83,000	148,000	38,000	80,000
1945	87,000	156,000	38,000	85,000
1946	90,000	170,000	40,000	88,000
1947	95,000	185,000	42,000	100,000
1948	100,000	200,000	44,000	115,000
1949	103,000	215,000	44,000	125,000
1950 (Apr.)	106,818	230,000	45,454	130,000
1951	108,000	240,000	46,000	138,000
1952	112,000	255,000	48,000	150,000
1953	119,000	275,000	50,000	162,000
1954	130,000	290,000	54,000	173,000
1955	140,000	310,000	85,000	180,000
1956	156,000	335,000	95,000	195,000
1957	172,000	355,000	100,000	208,000
1958	173,000	380,000	105,000	215,000
1959	245,000	410,000	110,000	230,000
1960 (Apr.)	434,277	434,277	209,305	252,650

EMPLOYMENT GROWTH

Rank	State	1948	1958	% Gain
1.	ARIZONA	154,300	279,600	81.2
2.	Florida	648,700	1,173,700	80.9
3.	Nevada	53,100	87,700	65.2
4.	New Mexico	133,300	217,800	63.4
5.	California	3,162,800	4,450,100	40.7
6.	Colorado	340,000	459,100	35.0
7.	Texas	1,842,000	2,457,300	33.7
8.	Utah	182,700	240,600	31.7
9.	Georgia	759,300	947,200	24.7
10.	Kansas	440,500	540,200	22.6

MANUFACTURING EMPLOYMENT

Rank	State	1948	1958	% Gain
1.	ARIZONA	15,400	39,200	154.5
2.	Florida	94,900	177,600	87.1
3.	California	734,200	1,176,900	60.3
4.	Nevada	3,300	5,100	54.5
5.	New Mexico	9,900	15,300	54.5
6.	Utah	27,500	39,000	41.8
7.	Kansas	84,300	115,400	36.9
8.	Texas	339,600	460,700	35.7
9.	Washington	174,500	218,600	25.3
10.	Colorado	57,600	71,600	24.3

MOTOR VEHICLE REGISTRATIONS IN ARIZONA

Year	Passenger Vehicles	Commercial Vehicles	Busses & Taxis	Trailers	Motor-Cycles	Total
1939	107,502	25,670	673	4,826	458	139,129
1940	113,646	26,878	715	5,260	549	147,048
1941	118,132	28,449	681	5,489	573	153,324
1942	114,493	28,093	794	6,057	708	150,145
1943	109,452	28,246	897	5,543	766	144,904
1944	110,130	28,372	827	6,158	884	146,371
1945	113,662	30,600	965	8,539	1,209	154,975
1946	124,541	36,405	1,085	12,873	1,592	176,496
1947	143,516	43,923	1,410	16,811	2,763	208,423
1948	162,264	50,606	1,446	20,029	3,600	237,945
1949	181,911	55,052	1,497	21,249	3,614	263,323
1950	205,819	60,854	1,457	22,336	3,673	294,139
1951	222,420	66,967	1,521	23,833	3,411	318,152
1952	250,802	74,582	1,695	27,076	3,546	357,701
1953	273,325	81,362	1,811	32,585	3,486	392,569
1954	289,999	84,991	1,586	32,601	3,616	412,793
1955	321,739	88,551	1,673	30,033	3,692	445,688
1956	351,126	95,498	1,636	38,253	3,884	490,397
1957	382,240	102,476	1,808	45,891	5,101	537,516
1958	407,818	109,347	2,058	53,108	7,237	579,568
1959	452,407	121,325	2,913	64,542	8,269	648,916

U. S. TRADE WITH MEXICO — ARIZONA CUSTOMS DISTRICT

Year	Value of Exports	Value of Imports	Total
1949	\$21,261,000	\$28,989,000	\$50,250,000
1950	21,935,000	24,390,000	46,325,000
1951	40,515,000	32,050,000	72,565,000
1952	41,500,000	35,791,000	77,291,000
1953	43,000,000	42,400,000	85,400,000
1954	44,600,000	24,500,000	69,100,000
1955	54,700,000	27,600,000	82,300,000
1956	51,600,000	31,300,000	82,900,000
1957	46,400,000	31,500,000	77,900,000
1958	43,400,000	47,300,000	90,700,000
1959	32,089,000	57,547,000	89,636,000

CLIMATE COMPARISON

Average Percentage of Possible Sunshine for Representative Cities

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
PHOENIX, Arizona	76	79	83	88	93	94	84	84	89	88	84	77	85
TUCSON, Arizona	78	83	84	90	92	93	75	81	90	90	90	84	86
Boston, Mass.	49	56	57	57	59	63	64	64	62	58	49	49	58
Chicago, Ill.	43	49	52	53	60	67	71	70	67	65	44	43	59
Cleveland, Ohio	27	34	44	51	58	64	68	66	62	56	33	29	49
Denver, Colo.	68	72	69	62	65	72	69	72	77	74	65	66	69
Detroit, Mich.	32	43	50	53	59	64	71	67	60	57	34	31	54
Houston, Texas	46	44	51	55	61	69	68	69	63	68	57	48	58
Los Angeles, Cal.	70	72	73	65	67	68	80	82	82	74	79	71	74
Miami, Florida	66	72	73	73	68	62	65	67	62	62	65	65	67
Minneapolis, Minn.	49	56	53	57	58	61	69	67	62	59	39	41	56
New Orleans, La.	49	50	57	63	68	65	58	59	64	69	60	47	59
New York, N. Y.	51	57	58	60	61	64	65	63	64	63	56	53	60
Pittsburgh, Pa.	37	40	50	51	58	64	63	59	65	58	48	35	54
Portland, Ore.	21	33	34	49	50	44	69	61	60	42	27	19	44
St. Louis, Mo.	45	50	56	59	65	66	72	70	70	69	56	45	60
San Francisco, Cal.	54	58	66	69	70	73	64	63	71	69	64	52	65
Seattle, Wash.	28	34	42	49	53	48	62	57	54	36	28	24	45
Washington, D.C.	46	53	56	57	61	64	64	62	62	61	54	47	58

Average Relative Humidity for Representative Cities (11:00 AM Recordings)

PHOENIX, Arizona	47	41	34	28	20	18	31	36	30	32	34	43	33
TUCSON, Arizona	40	34	29	22	17	16	33	38	29	30	29	36	30
Boston, Mass.	59	58	55	53	55	56	55	56	56	55	57	57	56
Chicago, Ill.	70	67	60	53	53	54	51	52	50	51	62	69	58
Cleveland, Ohio	72	68	62	55	54	54	53	54	53	55	64	70	60
Denver, Colo.	44	44	41	40	39	34	33	33	32	34	39	40	38
Detroit, Mich.	70	67	61	53	52	54	51	52	54	55	64	70	59
Houston, Texas	66	64	59	60	59	59	58	58	59	55	57	64	60
Los Angeles, Cal.	46	45	47	51	52	54	49	49	47	47	38	43	47
Miami, Florida	59	56	55	56	59	62	64	62	66	63	60	61	60
Minneapolis, Minn.	71	68	64	53	50	56	54	55	55	54	68	73	60
New Orleans, La.	67	64	60	59	59	60	64	63	62	58	60	66	62
New York, N. Y.	62	59	56	54	56	58	57	60	60	58	60	62	59
Pittsburgh, Pa.	68	65	58	53	50	54	53	54	54	56	58	66	57
Portland, Ore.	81	80	70	66	66	66	63	65	67	79	82	84	72
St. Louis, Mo.	65	62	56	54	54	54	50	53	54	52	59	65	57
San Francisco, Cal.	68	66	62	65	66	68	75	74	68	62	63	71	67
Seattle, Wash.	80	78	70	63	61	63	62	67	71	79	82	83	72
Washington, D.C.	56	53	48	45	48	52	52	53	53	51	51	55	51

Source: Louis R. Jurwitz, Meteorologist, U. S. Weather Bureau

ALTITUDE, TEMPERATURE AND RAINFALL FOR ARIZONA CITIES

City	Elevation In Feet	Average Annual Temperature	Normal Precipitation (Inches per Year)
Ajo	1,763	71.3	8.80
Alpine	8,000	43.4	20.40
Benson	3,550	62.7	11.55
Bisbee	5,350	62.2	18.62
Buckeye	980	69.8	7.22
Casa Grande	1,390	69.4	7.83
Clifton	3,465	67.0	11.84
Coolidge	1,419	68.7	8.28
Douglas	4,136	62.8	12.16
Flagstaff	6,903	46.4	18.42
Florence	1,500	69.6	9.49
Gila Bend	737	72.3	5.51
Globe	3,510	62.3	15.13
Grand Canyon	6,912	49.3	15.35
Holbrook	5,069	55.2	8.06
Kingman	3,333	61.5	10.09
Litchfield Park	1,030	69.7	7.67
McNary	7,320	46.7	23.97
Mesa	1,245	67.9	7.24
Miami	3,603	63.8	18.59
Nogales	3,800	60.3	15.91
Oracle	4,600	62.4	18.70
Parker	385	70.5	4.85
Payson	5,004	52.5	20.63
Phoenix	1,083	71.1	7.12
Prescott	5,354	52.9	19.98
Safford	2,900	64.1	8.71
Springerville	6,964	48.9	12.85
St. Johns	5,560	52.5	11.52
Tempe	1,180	68.4	7.77
Tombstone	4,540	63.4	14.05
Tucson	2,423	67.5	10.36
Whiteriver	5,200	55.8	17.50
Wickenburg	2,072	64.7	11.00
Willcox	4,200	58.5	11.84
Williams	6,750	50.7	21.13
Winslow	4,880	55.0	7.90
Yuma	138	73.1	3.62

Source: U. S. Weather Bureau Records

ESTIMATED TOURIST EXPENDITURES IN ARIZONA

	1958	1959
Food and Beverages	\$ 77,750,000	\$ 87,080,000
Lodging (Motels, Hotels, etc.)	55,550,000	62,160,000
Service Stations (Gas and Oil)	38,875,000	43,680,000
Miscellaneous Retail Purchases	18,875,000	21,000,000
Other Transportation	17,700,000	19,880,000
Auto Accessories and Repairs	16,750,000	18,760,000
Amusements, Recreation, etc.	12,250,000	13,720,000
Personal and Professional Services	12,250,000	13,720,000
	<u>\$250,000,000</u>	<u>\$280,000,000</u>

..... *appendix B - bibliography*



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Arizona Business Bulletin, Arizona State University Bureau of Business Services, Tempe.

Arizona Cattlelog, Arizona Cattle Growers' Association, Phoenix.

Arizona Days and Ways (Sunday magazine section of *The Arizona Republic*), Phoenix.

Arizona Farmer, 434 W. Washington, Phoenix.

Arizona Highways, Arizona State Highway Department, Phoenix.

Arizona Review of Business and Public Administration, Bureau of Business and Public Research, University of Arizona, Tucson.

Arizona Wildlife and Sportsman, Toney Publishing Company, Phoenix.

Arizoniana, Arizona Pioneers' Historical Society, Tucson.

Desert, Desert Publishing Company, Palm Desert, California.

Kiva, Arizona Archaeological and Historical Society, Tucson.

Plateau, Museum of Northern Arizona, Flagstaff.

Point West, Phoenix Point West, Inc., Phoenix.

Repositories

The following selected institutions have available larger collections of material on Arizona and the greater Southwest. Their special emphasis is indicated.

Arizona Pioneers' Historical Society, Tucson, Arizona

The state historical society is the official repository for Arizona newspapers. The research center has a special division housing over five hundred individual and family collections. Five thousand maps, forty thousand photographs and six thousand biographical folders make up a good part of the library. Other divisions hold the film library, oil paintings, magazines and journals, natural history, geology and mining.

Arizona State College, Flagstaff, Arizona

Special collections on Arizoniana, maps, books, pamphlets, and newspapers.

Arizona State Department of Library and Archives, Phoenix, Arizona

United States Documents Depository Library. Heavy emphasis on law and public records. Includes newspapers, maps, photographs, rare books and documents, diaries, journals, manuscripts and a Works Project Administration index to Arizona newspapers. Also a special Arizona book division.

Arizona State University, Matthews Library, Tempe, Arizona

United States Documents Library. Special collections on Arizona and Southwestern Americana, including maps, pictures, and original documents.

Henry E. Huntington Library and Art Gallery, San Marino, California

Original manuscripts, diaries, journals, maps relating to Arizona and the Southwest. Also collections of Arizona newspapers, photographs, magazines and journals. Large division of Arizona books and literature.

Museum of New Mexico Library, Santa Fe, New Mexico

Emphasis on Southwestern Americana, including Arizona history, anthropology and art. Special collections in archaeology, ethnology, Southwestern art, geography, travels, Spanish archival material, and the Adolph Bandelier journals.

Museum of Northern Arizona Library, Flagstaff, Arizona

Special collections on Southwestern geology, natural history, archaeology, ethnology, paleontology, and history.

Phoenix Public Library, Phoenix, Arizona

Good, wide variety of literature on Arizona and the Southwest, including rare books on history and anthropology. Other special collections in braille books and talking books.

Southwestern Archaeological Research Center, Globe, Arizona

United States National Park Service research center library with heavy emphasis on anthropology and history. Excellent book library with rare publications. Also collections of maps, photographs and manuscripts.

Southwest Museum Library, Los Angeles, California

Large collection of Southwestern Americana including the J. A. Munk library of Arizoniana and the Charles F. Lummis material. Heavy emphasis on ethnology and archaeology. Books, maps, photographs, manuscripts, diaries and journals.

University of Arizona Library, Tucson, Arizona

Special Collections division on Arizoniana including rare books, documents, individual and family collections. Extensive U. S. Government documents division. Maps, photographs, journals and magazines covering history, natural history, geology, and mining activities, masters theses and doctoral dissertations, mining prospectus and travel literature. The Department of Anthropology library has collections of books on anthropology and Arizona history, including some special collections.

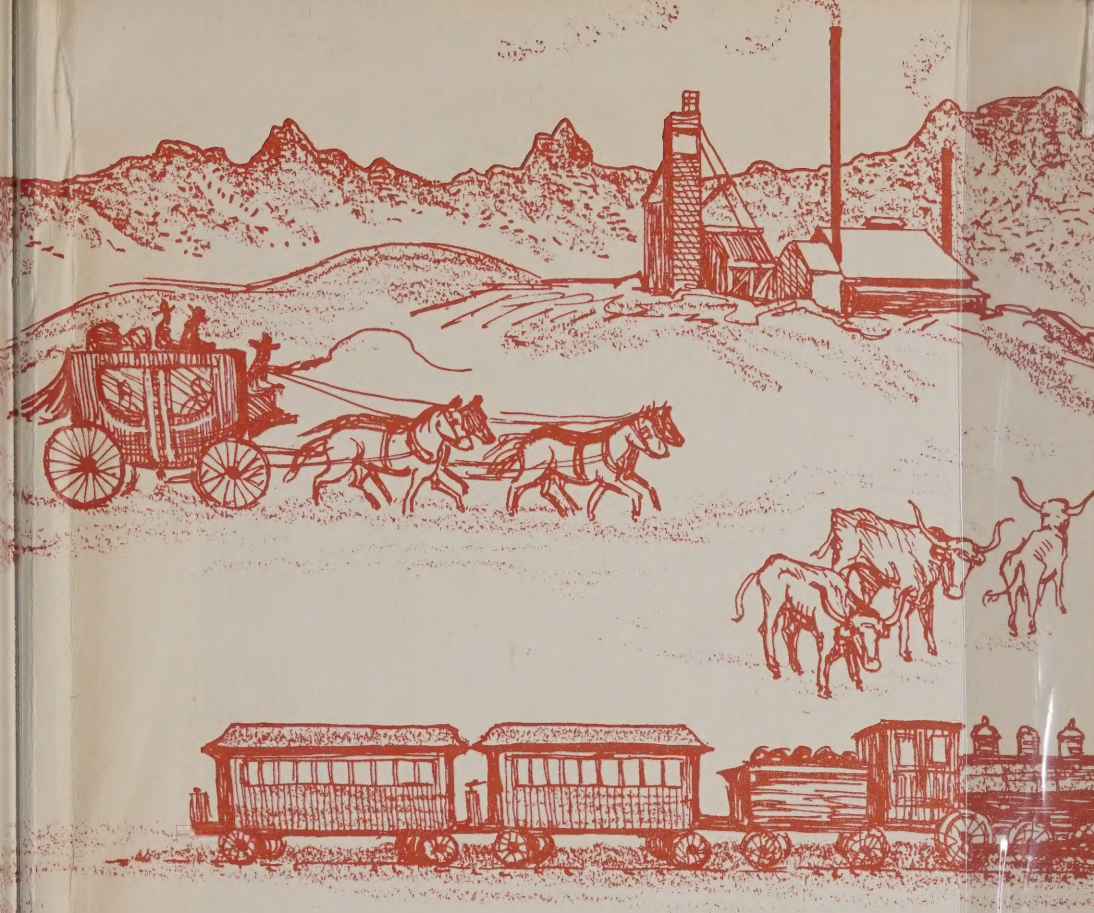
University of California, Bancroft Library, Berkeley, California

Western Americana including Arizona and the Southwest. Extensive holdings of books, diaries, journals, manuscripts, maps, and photographs. Also papers of early American leaders. Material in branch libraries on anthropology, architecture, astronomy, education, forestry, geology, mineral technology, paleontology and public health. The famous Bancroft library is the outstanding one of its kind.

This book was designed by the staff of the University of Arizona Press. The text, set by Tucson Typographic Service, is Times Roman, a type face created in 1932 by Stanley Morison for the London *Times*. Display heads are hand-set in Lydian. Arizona Lithographers of Tucson printed the edition on Baronet Offset Book paper. The volume was bound by the Arizona Trade Bindery in Phoenix.







—continued from front flap

central theme of water which underlies the development of modern Arizona. And following culture—the golden thread of Ariadne—through a labyrinth of change, the narrators have returned inevitably to a tradition that is unmistakably Arizona.

Five meaningful categories—history, resources, government, economy, and culture—have served as a loom on which to weave the Arizona tapestry. The work has been done largely by faculty of the University of Arizona at Tucson. In its own Seventy-Fifth Anniversary year—1960—and with the approach of the Territorial Centennial—1962—the University has established a Press, and has assembled there the volume of Arizona's best current knowledge about itself. The efforts of some sixty specialists and the editorial staff have made this volume instructively accurate, disarmingly educational, and graphically unforgettable—a unique anniversary gift from the University of Arizona to the state, and from the state to the nation.



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